Coastal Bend Regional Water Planning Area Region N

2021 Regional Water Plan

October 2020

Prepared by

Coastal Bend Regional Water Planning Group

With administration by

With technical assistance by

HDR Engineering, Inc

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Coastal Bend Regional Water Planning Area

Region N 2021 Regional Water Plan

Acknowledgements

The thoughtful consideration, input, public service, and direction of the members of the Coastal Bend Regional Water Planning Group is gratefully acknowledged in producing the water plan for this diverse planning area.

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Co-Chair	Mr. Scott Bledsoe III, Live Oak UWCD	Water Districts Representative
Secretary	Mr. Lonnie Stewart, Bee GCD, Live Oak UWCD, McMullen GCD, San Patricio County GCD	GMA 13
	Mr. Joe Almaraz, Valero	Industry Representative
	Mr. John Burris	Other
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	Ms. Teresa Carrillo, Coastal Bend Bays Foundation	Environmental Representative
	Mr. Carl Crull	Other, South Central Texas RWPG liason
	Mr. Bill Dove	Small Business Representative
	Mr. Lavoyger J. Durham	Counties Representative
	Mr. Gary Eddins	Electric Generating Utilities Representative
	Mr. Andy Garza	GMA 16
	Mr. Bill Hennings	Other (active 2015)
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	Ms. Barbara Reaves, City of Alice	Municipal Representative
	Mr. Charles Ring	Agricultural Representative
	Ms. Donna Rosson	Public Representative
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The efforts, long hours, and diligence is specially noted and appreciated of Ms. Rocky Freund.

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Coastal Bend Regional Water Planning Area
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2021 Plan

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Mr. Mark Sugarek, GMA 15

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Coastal Bend Regional Water Planning Area

2021 Regional Water Plan

This Regional Water Plan is released for planning purposes on October 23, 2020 by HDR Engineering, Inc., 8404 Indian Hills Dr., Omaha, NE 68114, Texas Registered Firm F-754 and the following individuals presented below.

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Coastal Bend
Regional Water Planning Area
Region N

2021 Regional Water Plan

Prepared for:

Texas Water Development Board

Prepared by:

Coastal Bend Regional Water Planning Group

With Administration by:

Nueces River Authority

With Technical Assistance by:

HDR Engineering, Inc.

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October 2020

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List of Acronyms

ac-ft	acre-feet
ac-ft/yr	acre-feet per year
ASR	Aquifer Storage and Recovery
BBASC	Basin and Bay Area Stakeholder Committee
BBEST	Basin and Bay Expert Science Team
BEG	Bureau of Economic Geology
BMPs	Best Management Practices
BOD_5	Biochemical Oxygen Demand (5-Day)
BRACS	Brackish Resource Aquifer Characterization System
C/BOD_5	Carbonaceous Biochemical Oxygen Demand (5-Day)
CA	Certificate of Adjudication
$CaCO_3$	Calcium Carbonate
CBBEP	Coastal Bend Bays and Estuaries Program
CBRWPG	Coastal Bend Regional Water Planning Group
CCR	Choke Canyon Reservoir
CCR/LCC	Choke Canyon Reservoir/Lake Corpus Christi
CCWSM	Corpus Christi Water Supply Model
cfs	cubic feet per second
CFU	Colony Forming Units
CGCGAM	Central Gulf Coast Groundwater Availability Model
DBPs	Disinfection Byproducts
DCPs	Drought Contingency Plans
DFCs	Desired Future Conditions
DOR	Drought of Record
DPC	Drought Preparedness Council
EDAP	Economic Development Assistance Program
EFAG	Environmental Flows Advisory Group
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ft-msl	feet mean sea level
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GIS	Geographic Information System
GLO	General Land Office
GMA	Groundwater Management Area
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute

GSA WAM	Guadalupe - San Antonio River Basin Water Availability Model
GW	groundwater
HAA	Haloacetic Acid
HB	House Bill
kWh or kW-hr	kilowatt-hour
LCC	Lake Corpus Christi
LEPA	Low Energy Precision Application
LESA	Low Elevation Spray Application
LNRA	Lavaca-Navidad River Authority
LOUWCD	Live Oak Underground Water Conservation District
LSI	Langlier Saturation Index
MAG	Modeled Available Groundwater
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
mgd or MGD	million gallons per day
mi	mile
ml or mL	milliliter
mo	month
MRP	Mary Rhodes Pipeline
MSA	Metropolitan Statistical Area
msl	mean sea level
MUD	Municipal Utility District
MWD	Municipal Water District
N/A	not available or not applicable
NCWC&ID#3	Nueces County Water Control and Improvement District #3
NDD	Natural Diversity Database
NEAC	Nueces Estuary Advisory Council
NPDES	National Pollutant Discharge Elimination System
NRA	Nueces River Authority
NTU	Nephelometric Turbidity Units
NUBAY	Lower Nueces River Basin and Estuary Model
O&M	Operation and Maintenance
psi	pounds per square inch
REIS	Regional Economic Information System
RO	Reverse Osmosis
ROI	Return on Investment
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
SAC	Science Advisory Committee
SB1	Senate Bill 1

SB3	Senate Bill 3
SMART	Salinity Monitoring and Real Time Inflow Management
SPMWD	San Patricio Municipal Water District
STWA	South Texas Water Authority
SW	surface water
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TWC	Texas Water Code
TWDB	Texas Water Development Board
TXNDD	Texas Natural Diversity Database
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UWCD	Underground Water Conservation District
WAM	Water Availability Model
WCID	Water Control and Improvement District
WMS	Water Management Strategies
WRAP	Water Rights Analysis Package
WSC	Water Supply Corporation
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plant
yr	year

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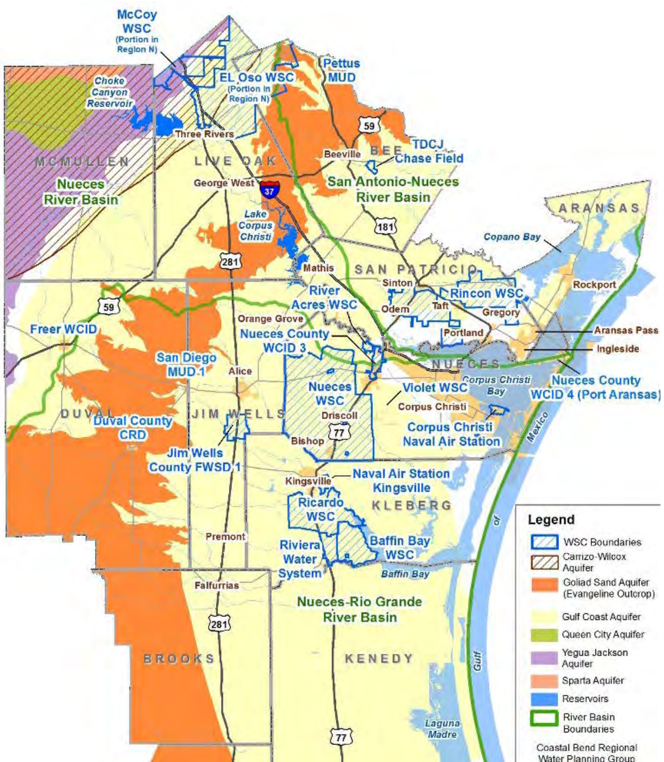

Executive Summary

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Executive Summary

ES.1 Background

Since 1957, the Texas Water Development Board (TWDB) has been charged with preparing a comprehensive and flexible long-term plan for the development, conservation, and management of the State's water resources. The current state water plan, *2017 State Water Plan*, was produced by the TWDB and based on approved regional water plans pursuant to requirements of Senate Bill 1 (SB1), enacted in 1997 by the 75th Legislature. As stated in SB1, the purpose of the regional water planning effort is to:

> "Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."

SB1 also provides that future regulatory and financing decisions of the Texas Commission on Environmental Quality (TCEQ) and the TWDB be consistent with approved regional plans.

The TWDB divided the state into 16 planning regions and appointed members to the regional planning groups. As shown is Figure ES.1, the Coastal Bend Region (Region N) includes 11 counties. The Coastal Bend Regional Water Planning Group (CBRWPG) has a total of 22 voting members. The members represent 13 interests or stakeholders (Agriculture, Counties, Electric Generating Utilities, Environmental, Groundwater Management Areas, Industries, Municipalities, Other, Public, River Authorities, Small Business, Water Districts, and Water Utilities), serve without pay, and are responsible for the development of the Coastal Bend Regional Water Plan (Table ES.1). The following members have served since inception of the CBRWPG in the late 1990s: Mr. Scotty Bledsoe, Mr. Robert Kunkel, and Ms. Carola Serrato.

The CBRWPG adopted bylaws to govern its operations and, in accordance with its bylaws, selected the Nueces River Authority to serve as its administrative agency.

Pursuant to Regional and State Water Planning Guidelines (Texas Administrative Code, Title 31, Part 10, Chapters 357 and 358), the CBRWPG developed the 2001, 2006, 2011, and 2016 Regional Water Plans, which were then integrated into Water for Texas – 2002, 2007, 2012 and 2017 respectively, by the TWDB. The 2021 Coastal Bend Regional Water Plan, of which this Executive Summary is a part, represents the fifth update of a plan as presently required to occur on a five-year cycle. The TWDB will integrate this Regional Water Plan into a State Water Plan to be issued in 2022.

This executive summary and the accompanying *Regional Water Plan* convey water supply planning information, projected population and water demands, projected needs in the region, proposed water management strategies to meet those needs, and other findings. Table ES.2 shows the contents of the plan.

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Figure ES.1.
Coastal Bend Regional Water Planning Area

Table ES.1.
Coastal Bend RWPG Members (as of January 2020)

Interest Group	Name	Entity
Voting Members		
Agriculture	Mr. Charles Ring	
	Mr. Chuck Burns	Rancher
Counties	Mr. Bill Stockton	
	Mr. Lavoyger J. Durham	
Electric Generating Utilities	Mr. Gary Eddins	
Environmental	Ms. Teresa Carrillo	Coastal Bend Bays Foundation
	Mr. Jace Tunnell	UT Marine Science Institute
Groundwater Management Areas	Mr. Lonnie Stewart, Secretary	GMA 13
	Mr. Mark Sugarek	GMA 15
	Mr. Andy Garza	GMA 16
Industry	Mr. Joe Almaraz	Valero
	Mr. Robert Kunkel	Lyondell Basell
Municipal	Mr. Mark Scott	
	Ms. Barbara Reaves	
Other	Mr. John Burris	
	Mr. Carl Crull, P.E.	
Public	Ms. Donna Rosson	
River Authorities	Mr. Thomas M. Reding, Jr., Executive Committee	Nueces River Authority
Small Business	Dr. Pancho Hubert, Executive Committee	
	Mr. Bill Dove	
Water Districts	Mr. Scott Bledsoe III, Co-Chair	Live Oak UWCD
Water Utilities	Ms. Carola Serrato, Co-Chair	South Texas Water Authority
Non-Voting Members		
	Mr. Kevin Smith	Texas Water Development Board
	Ms. Nelda Garza	Texas Department of Agriculture
	Dr. Jim Tolan	Texas Parks and Wildlife Department
	Mr. Tomas Dominguez	USDA – NRCS
Liaison, South Central Texas RWPG	Mr. Carl Crull, P.E.	
Liaison, Rio Grande RWPG	Judge Humberto Gonzalez	Jim Hogg County
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Table ES.2. Plan Structure

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Chapter 4B	Technical Memorandum (September 8, 2018)
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	Port of Corpus Christi Authority- La Quinta Channel
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Chapter 7	Drought Response Information, Activities, and Recommendations
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Chapter 10	Public Participation, Adoption, Submittal, and Approval of Regional Plan
Chapter 11	Implementation and Comparison of Plan to Previous Regional Water Plans
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ES.2 Description of the Region

The area represented by the Coastal Bend Region includes the following counties: Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio (Figure ES.1). The Coastal Bend Region has four current regional Wholesale Water Providers: the City of Corpus Christi (City), San Patricio Municipal Water District (SPMWD), South Texas Water Authority (STWA), and Nueces County Water Control and Improvement District #3 (Nueces County WCID #3). The City, the largest of the four, sells water to two of the other regional water providers — SPMWD and STWA. The City and the SPMWD distribute water to cities, water districts, and water supply corporations for residential, commercial, and industrial customers. STWA provides water to cities and water supply corporations that supply both residential and commercial customers within the western portion of Nueces County as well as Kleberg County. The smallest regional wholesale water provider, Nueces County WCID #3, provides water to the City of Robstown and River Acres WSC. The major water demand areas are primarily municipal systems in the greater Corpus Christi area, as well as large industrial (manufacturing, steam-electric, and mining) users primarily located along the Corpus Christi and La Quinta Ship Channels. Based on state surveys of industrial water use, industries in the Coastal Bend area are very efficient in their water use. For example, petroleum refineries in the Coastal Bend area use on average 60 percent less water to produce a barrel of refined crude oil than refineries in the Houston/Beaumont area.

The Coastal Bend Region depends mostly on surface water sources for municipal and industrial water supply use. The major surface water supply source is the regional Choke Canyon/Lake Corpus Christi/Lake Texana/Mary Rhodes Pipeline Phase II system (Corpus Christi Regional Water Supply System) through the City of Corpus Christi. Surface water supply relationships are discussed in greater detail in Chapter 3.

The Coastal Bend Region depends on groundwater supplies for irrigation, mining, and less populated municipal areas that are not served by the Corpus Christi Regional Water Supply System. There are two major aquifers that lie beneath the region — the Carrizo and Gulf Coast aquifers. The Gulf Coast Aquifer is the predominant aquifer for groundwater supplies, providing about 95% of the groundwater used in the region. The Gulf Coast Aquifer underlies all counties within the Coastal Bend Region and yields moderate to large amounts of both fresh and slightly saline water. The Carrizo Aquifer underlies parts of McMullen, Live Oak, and Bee Counties and contains moderate to large amounts of either fresh or slightly saline water. Only Live Oak County developed a modeled available groundwater (MAG) estimate for the Carrizo Aquifer. The Queen City, Sparta, and Yegua-Jackson Aquifers are minor aquifers and underlie parts of McMullen County. A modeled available groundwater (MAG) estimate was not identified for the Yegua-Jackson Aquifer.

According to estimates provided by the Texas Water Development Board (TWDB), the historical population of Region N was 505,224 in 2010. In 2020, the population of the Coastal Bend Region is estimated to be 614,790. The regional average per capita income in 2017 was

$40,987, ranging from $27,543 in Bee County to $68,178 in McMullen County.[1] The Corpus Christi Metropolitan Statistical Area (MSA), consisting of Aransas, Nueces, and San Patricio Counties, accounts for 81 percent of the Coastal Bend Region's population and 80 percent of the total personal income. In 2017, the total personal income in the Coastal Bend Region was nearly $23.8 billion.

The primary economic activities within the Coastal Bend Region include transportation and warehousing, oil/gas extraction and mining services, manufacturing, agriculture, forestry, fishing and hunting. In 2017, there were 192,089 people employed in the Coastal Bend Region with annual compensation to employees of over $7.8 billion.[2] The service industry sector had the biggest economic impact in 2017, with a total compensation to employees of $2.69 billion. The service industry sector includes information, public administration, educational, health care, social services businesses, finance and insurance, and real estate. In 2017, 22% of the local workforce was employed by this sector. The retail/wholesale trade sector is also a large contributor to the local economy. In 2017, 18% of the local workforce (over 42,000 people) was employed by this sector, receiving total compensation of $600 million. Oil and gas extraction, manufacturing, and construction activities employed over 39,000 people within the region and general annual compensation to employees of nearly $1.24 billion. Agriculture, forestry, fishing, and hunting also add to the economic value of the Coastal Bend Region.

ES.3 Population and Water Demand Projections

For the 2021 Coastal Bend Regional Water Plan, the TWDB issued population and water demand projections to Region N based on 2010 census data. As no new census data were available, county-wide population totals are the same as those in the 2016 Region N Plan/2017 State Water Plan. A key difference with this new planning cycle is that the 2017 State Water Plan population and municipal demands are transitioned from political boundaries to utility service areas for development of the 2021 Regional Water Plan. The CBRWPG requested population revisions for Nueces WSC and water demand revisions for Nueces and San Patricio County manufacturing users, and for all counties with projected irrigation water demands. The TWDB approved projection revisions in April 2018.

ES.3.1 Population Projections

Figure ES.2 illustrates population growth in the entire Coastal Bend Region for 2010 and projected growth through 2070. In 2070, the population of the Coastal Bend Regional Water Planning Area is projected to be 744,544.

[1] U.S. Department of Commerce Bureau of Economic Analysis, Regional Economic Information System (REIS) Database, 2017.
[2] 2017 United States Census Bureau, 2017 Economic Annual Survey County Business Patterns, CB1700CBP, November 2019.

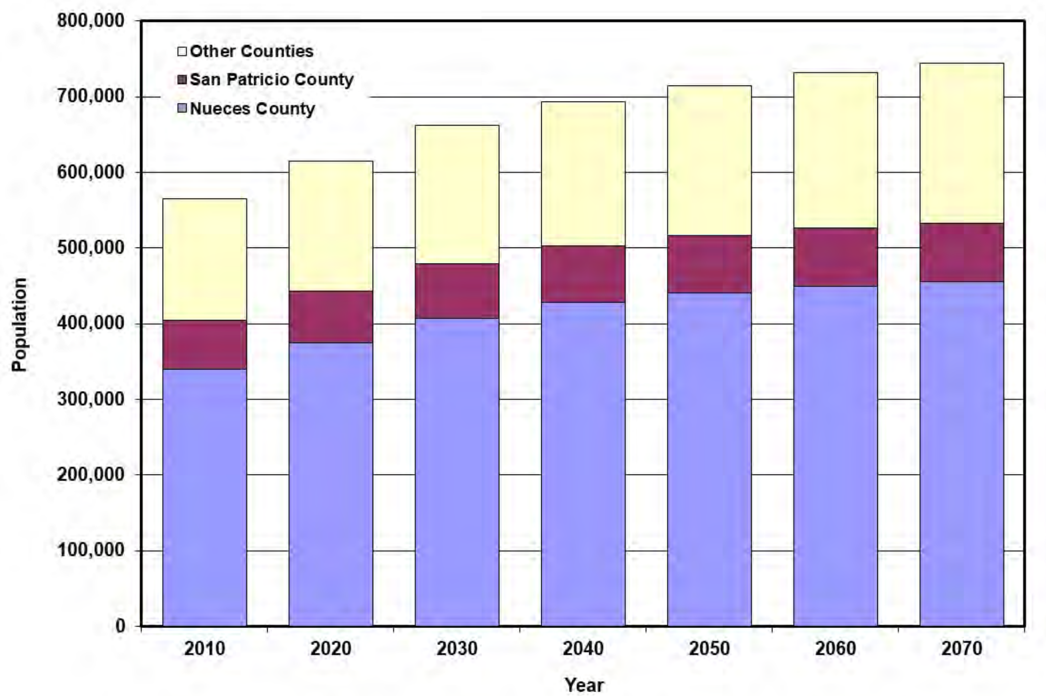


Figure ES.2.
Historical and Projected Coastal Bend Regional Water Planning Area Population

As can be seen in Figure ES.3, the average annual growth rate of the region over the 50-year planning period is 0.46 percent. Brooks, Jim Wells, Kleberg, and McMullen Counties have growth rates higher than the regional average, while the other counties have lower growth rates than the average. These annual growth rates were based on TWDB projections, and, if projected industrial growth occurs, then the actual annual growth rates may be higher.

ES.3.2 Water Demand Projections

Water demand projections have been compiled for six categories of water use: 1) Municipal; 2) Manufacturing; 3) Steam-Electric Power; 4) Mining; 5) Irrigation; and 6) Livestock.

Water User Groups

Each of these consumptive water uses is termed a “water user group.” Incorporated cities and County-Other category are water user groups within the Municipal Use category. The County-Other category includes persons residing outside of cities and also outside water utility boundaries. Water demand projections and supplies have been estimated for all water user groups.

Total water use for the region is projected to increase from 187,788 ac-ft in 2010 to 276,492 ac-ft in 2070, a 47.2 percent increase, primarily attributable to projected industrial growth. The six types of water use and associated demands are shown in Figure ES.4. The projected trend in total water use from 2020 to 2070 is shown in Figure ES.5. Municipal, manufacturing, mining, steam-electric, and irrigation water use are all projected to increase, while livestock use is projected to remain constant from 2020 to 2070.

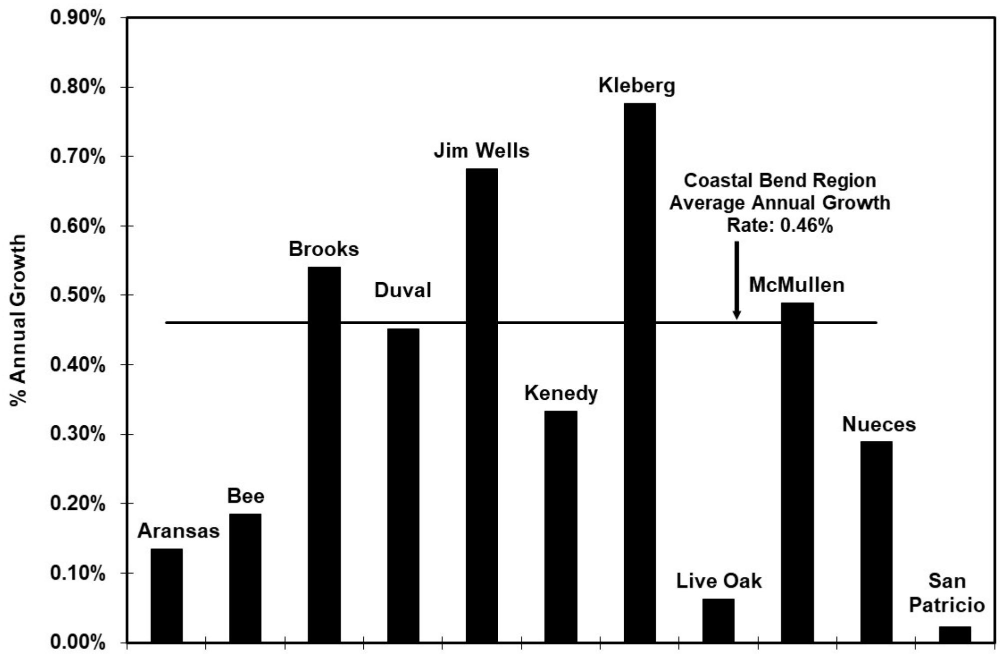


Figure ES.3.
Percent Annual Population Growth Rate for 2020 through 2070 by County

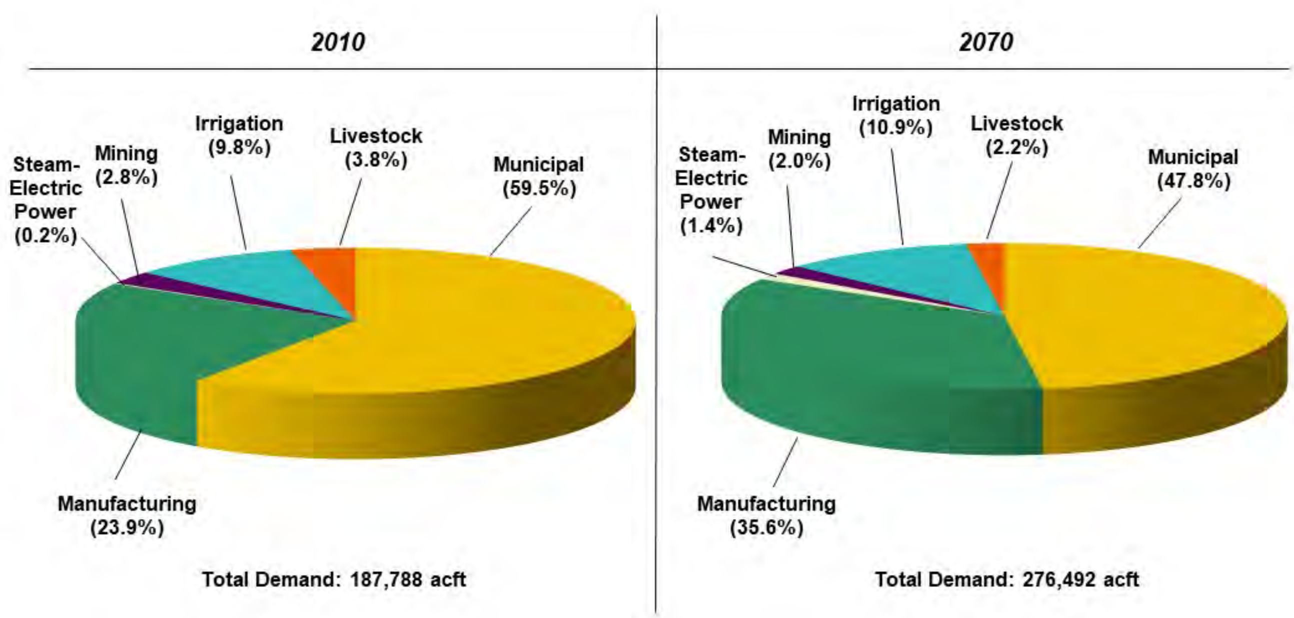


Figure ES.4.
Total Region N Water Demand by Type of Use

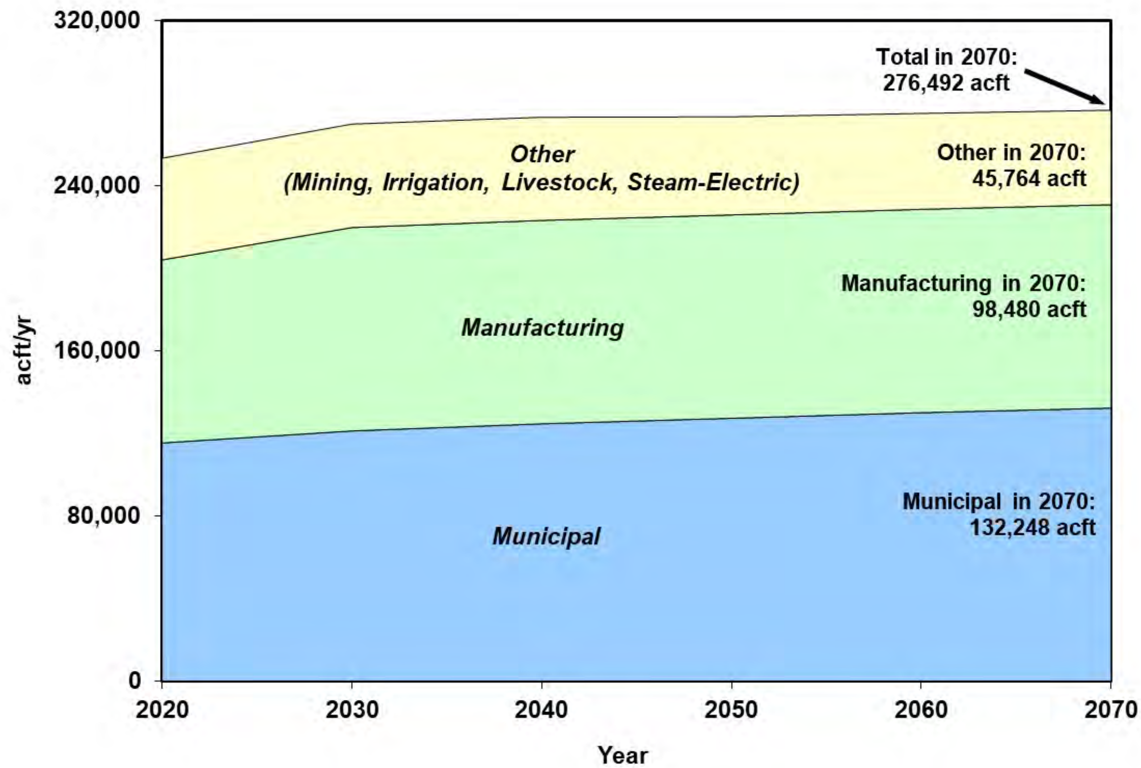


Figure ES.5.
Projected Total Region N Water Demand

ES.4 Water Supply

ES.4.1 Surface Water Supplies

Streamflow in the Nueces River and its tributaries, along with reservoirs in the Nueces River Basin and interbasin transfers from Lake Texana and the Colorado River, comprise the most significant supplies of surface water in the Coastal Bend Region. Water rights associated with major water supply reservoirs are owned by the City of Corpus Christi and the Nueces River Authority. The western and southern parts of the region are heavily dependent on groundwater sources, due to limited access to surface water supplies.

Municipal Use and Water Conservation

The 6.3 percent projected increase in municipal water demand over the 50-year planning horizon is lower than the projected population increase of 21.1 percent due to expected savings in per capita water use resulting from water conservation. Average per capita municipal water use in 2011 was 171 gallons per capita per day and is projected to decrease to 153 gallons per capita per day by 2070 due to built-in savings for low flow plumbing fixtures, which reduces municipal water demand by 961 ac-ft/yr by 2070.

Many entities within the Coastal Bend Region obtain surface water through water supply contracts. The City is the largest provider of water supplies in the Coastal Bend Region with 178,000 ac-ft/yr raw water safe yield available from its CCR/LCC/Texana/MRP Phase II reservoir system (2020 sediment conditions).[3] Run-of-river water rights provide 384 ac-ft/yr of reliable water for Nueces County WCID #3 and 1,500 ac-ft/yr for the City of Three Rivers firmed up with storage. Other surface water supplies are provided by on-farm local sources and reuse.

In addition to raw water supply contracts and/or availability, total surface water supplies are constrained based on existing water treatment plant capacities as discussed in Chapter 4. As shown in Table ES.3, total surface water from all surface water sources in year 2070 is 168,674 ac-ft/yr, of which 99 percent is provided by the City's supplies.

Table ES.3.
Surface Water Supply in 2070 (ac-ft)

Municipal	103,478
Manufacturing	60,109
Steam-Electric	3,996
Mining	0
Irrigation	0
Livestock	1,091
Total	**168,674**

Note: This table considers both treatment plant capacity and raw water constraints.

ES.4.2 Groundwater Supplies

Two major aquifers and three minor aquifers underlie parts of the Coastal Bend Planning Region (Figure ES.1) and have a combined reliable yield of 187,096 ac-ft/yr in 2070 based on modeled available groundwater (MAG) estimates provided by the TWDB for CBRWPG use (Table ES.4). The projected groundwater use in 2070 is 58,455 ac-ft/yr for current water users, or 96,611 ac-ft/yr if recommended water management strategies are implemented.[4] The two major aquifers include the Gulf Coast Aquifer, which supplies 95% of the groundwater to the region in 2020, and the Carrizo Aquifer, which supplies water to the northwest portion of the region in parts of McMullen County (Figure ES.1). Groundwater supplies are based on MAG estimates and well capacities. In the northwestern part of the region, the Carrizo-Wilcox is a prolific aquifer with lesser quality water in most areas. The Yegua-Jackson, Queen City, and Sparta aquifers are minor aquifers relied on for very small amounts of local supply in McMullen County.

ES.4.3 Total Supplies

Total water use from each water source is summarized in Table ES.5. No supplies are over allocated. The total existing water supplies, including both groundwater and surface water

[3] The City of Corpus Christi holds a contract with the Lavaca-Navidad River Authority for a base amount of 31,440 ac-ft/yr and a maximum of 12,000 ac-ft/yr on an interruptible basis from Lake Texana to the City, and up to 35,000 ac-ft/yr from the City's Garwood water rights. The safe yield estimate includes system operation of CCR/LCC/Texana/MRP Phase II supplies with a 75,000 ac-ft reserve during drought of record conditions.
[4] Based on recommended water management strategies, which are constrained by modeled available groundwater (MAG) limits.

supplies, by water user category and decade is summarized in Table ES.6. Pertinent database tables (DB22) required for inclusion by TWDB guidance are included in Appendix A.

Table ES.4.
Groundwater Availability and Use from Aquifers within the Coastal Bend Region

County Name	Basin Name	Aquifer Name	TWDB Provided MAG for 2021 Region N Plan (ac-ft/yr)					
			2020	**2030**	**2040**	**2050**	**2060**	**2070**
Aransas	San Antonio-Nueces	Gulf Coast	1,542	1,542	1,542	1,542	1,542	1,542
Bee	Nueces	Carrizo	0	0	0	0	0	0
Bee	San Antonio-Nueces	Gulf Coast	17,640	18,917	19,526	19,776	19,951	19,951
Bee	Nueces	Gulf Coast	797	920	976	1,005	1,022	1,022
Brooks	Nueces-Rio Grande	Gulf Coast	5,582	6,352	7,122	7,892	7,892	7,892
Duval	Nueces	Gulf Coast	326	351	376	401	428	428
Duval	Nueces-Rio Grande	Gulf Coast	20,245	21,818	23,388	24,962	26,535	26,535
Jim Wells	Nueces	Gulf Coast	593	593	593	593	593	593
Jim Wells	Nueces-Rio Grande	Gulf Coast	8,551	9,090	9,593	10,132	10,424	10,424
Kenedy	Nueces-Rio Grande	Gulf Coast	13,301	18,621	23,941	29,261	29,261	29,261
Kleberg	Nueces-Rio Grande	Gulf Coast	10,365	13,082	15,800	18,518	18,711	18,711
Live Oak	San Antonio-Nueces	Gulf Coast	41	46	42	41	41	41
Live Oak	Nueces	Gulf Coast	8,297	9,297	8,522	8,400	8,400	8,400
Live Oak	Nueces	Carrizo	0	0	0	0	0	0
McMullen	Nueces	Carrizo	7,056	7,056	4,405	4,405	4,405	4,405
McMullen	Nueces	Gulf Coast	510	510	510	510	510	510
McMullen	Nueces	Queen City	134	134	134	134	134	134
McMullen	Nueces	Sparta	89	89	89	89	89	89
McMullen	Nueces	Yegua-Jackson	0	0	0	0	0	0
Nueces	San Antonio-Nueces	Gulf Coast	0	0	0	0	0	0
Nueces	Nueces	Gulf Coast	727	756	787	816	845	845
Nueces	Nueces-Rio Grande	Gulf Coast	5,862	6,191	6,522	6,851	7,079	7,079
San Patricio	San Antonio-Nueces	Gulf Coast	39,481	40,514	41,548	42,581	43,615	43,615
San Patricio	Nueces	Gulf Coast	4,130	4,502	4,874	5,247	5,619	5,619
Total Groundwater Availability (ac-ft/yr)			**145,269**	**160,381**	**170,290**	**183,156**	**187,096**	**187,096**
Gulf Coast Aquifer-MAG (ac-ft/yr)			**137,990**	**153,102**	**165,662**	**178,528**	**182,468**	**182,468**

Table ES.5.
Total Source Water Availability and Supply by Source (ac-ft)

	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Total Source Water Availability						
CCR/LCC/Texana/MRP2 System	178,000	176,100	173,900	171,700	169,500	167,000

Run-of-River (Firm Yield)	384	384	384	384	384	384
Stock Ponds/On-site/Reuse	1,075	1,075	1,091	1,091	1,091	1,091
Gulf Coast- Groundwater	137,990	153,102	165,662	178,528	182,468	182,468
Carrizo Wilcox- Groundwater	7,056	7,056	4,405	4,405	4,405	4,405
Queen City- Groundwater	134	134	134	134	134	134
Sparta- Groundwater	89	89	89	89	89	89
Yegua Jackson- Groundwater	—	—	—	—	—	—
Total Source Water Availability (ac-ft)	**324,728**	**337,940**	**345,665**	**356,331**	**358,071**	**355,571**
Existing Water Supply[1]						
CCR/LCC/Texana/MRP Phase II	176,744	174,822	172,604	170,397	168,196	165,699
Run-of-River[2]	1,884	1,884	1,884	1,884	1,884	1,884
Stock Ponds/On-site/Reuse	1,075	1,075	1,091	1,091	1,091	1,091
Gulf Coast- Groundwater	55,855	56,384	56,781	57,086	57,075	57,282
Carrizo Wilcox- Groundwater	3,907	4,470	4,401	2,267	1,495	950
Queen City- Groundwater	134	134	134	134	134	134
Sparta- Groundwater	89	89	89	89	89	89
Yegua Jackson- Groundwater	—	—	—	—	—	—
Total Existing Water Supply (ac-ft)	**239,688**	**238,858**	**236,984**	**232,948**	**229,964**	**227,129**

[1]The existing supply takes into consideration physical, treatment, and legal (contractual) constraints.

[2]Includes run-of-river rights and those with storage rights, other than those associated with the Corpus Christi Regional Water System (CCR/LCC/Texana/MRP Phase II).

Table ES.6.
Summary of Total Existing Water Supplies* by Water User Category (ac-ft)

	2020	2030	2040	2050	2060	2070
Municipal	105,132	110,628	113,887	116,394	118,916	121,016
Manufacturing	88,824	82,046	76,971	72,739	68,256	64,039
Steam-Electric	3,996	3,996	3,996	3,996	3,996	3,996
Mining	6,748	7,391	7,333	5,021	3,999	3,281
Irrigation	28,923	28,732	28,732	28,732	28,732	28,732
Livestock	6,065	6,065	6,065	6,065	6,065	6,065
Total (ac-ft)	**239,688**	**238,858**	**236,984**	**232,948**	**229,964**	**227,129**

*Note: This table considers physical, treatment, and legal (contractual) constraints.

ES.4.4 Supply and Demand Comparison

The Coastal Bend Region shows water supply shortages throughout the 50-year planning cycle. Beginning in 2020 a shortage of 13,530 ac-ft exists within the Region and increases to a shortage of 49,363 ac-ft by 2070. A small portion of this shortage is associated with treatment plant capacity constraints and is not necessarily a raw water shortage. Current O.N. Stevens WTP improvements are in progress to increase treatment plant capacity, which should be sufficient to address water needs through 2070 with recommended water management strategies for additional supplies.

Nine of the eleven counties in the region have a projected shortage in at least one of the water user groups in the county. These are Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, and San Patricio counties. Figure ES.6 shows these water user groups with shortages for both 2040 and 2070 timeframes. None of the water user groups in Aransas or McMullen counties have projected shortages.

Constraints on Water Supply

Water supplies are also affected by contractual arrangements and infrastructure constraints. Expiring contracts, insufficient well capacity, and water treatment plant capacity — each of these supply constraints was taken into account in estimating water supplies available to water user groups. Consequently, the water supply listed for a given city may be less than the quantity in their water purchase contract or water right.

ES.4.5 Additional Plan Information

Although the majority of the plan is focused on assessing supplies (Chapter 3), identifying needs (Chapter 4), and evaluating water management strategies to address projected shortages (Chapter 5), there are additional report sections of interest. Chapter 6 summarizes the impact of water management strategies on key parameters of water quality in the region. Chapter 7 presents drought response information for the region and activities and recommendations to mitigate future drought impacts on water supply. Chapter 8 presents legislative recommendations and unique stream segments/reservoirs from the CBRWPG. Chapter 10 summarizes the public participation process, regional meetings held, and CBRWPG approval of the regional plan on February 20, 2020. Chapter 11 compares this plan to previous plans.

ES.5 Wholesale Water Providers

The Coastal Bend Region has four current wholesale water providers. These include the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID #3. The City of Corpus Christi supplies about 52 percent of the water demand in the region (not including supplies to SPMWD or STWA). SPMWD and STWA purchase 100 percent of their water from the City of Corpus Christi. The SPMWD subsequently treats and distributes water to numerous entities and supplies about 10 percent of the municipal and industrial water demand in the region. Both STWA and Nueces County WCID #3 provide less than 3 percent of the municipal and industrial water demand in the region. These four wholesale water providers were designated as major water providers by the CBRWPG. Two potential future wholesale water providers were identified in DB22 for recommended water management strategies: the Port of Corpus Christi Authority (PCCA) and Poseidon Water. Both are associated with seawater desalination strategies to primarily serve future San Patricio County and Nueces County manufacturing users.

Figure ES.7 and Figure ES.8 show projected supply and demand for each of the four current wholesale water providers. The City of Corpus Christi, after meeting demands and/or contracts with its customers, has raw water supply shortages from 2030 through 2070, indicating a need for increased source water supplies. In addition, beginning in 2030, the City and its treated industrial water customers have shortages associated with treatment plant capacity constraints. The City is in the process of O.N. Stevens WTP Improvements to increase system capacity to meet future treated water needs (See Section 5D.11). The City's shortages are applied to Nueces County

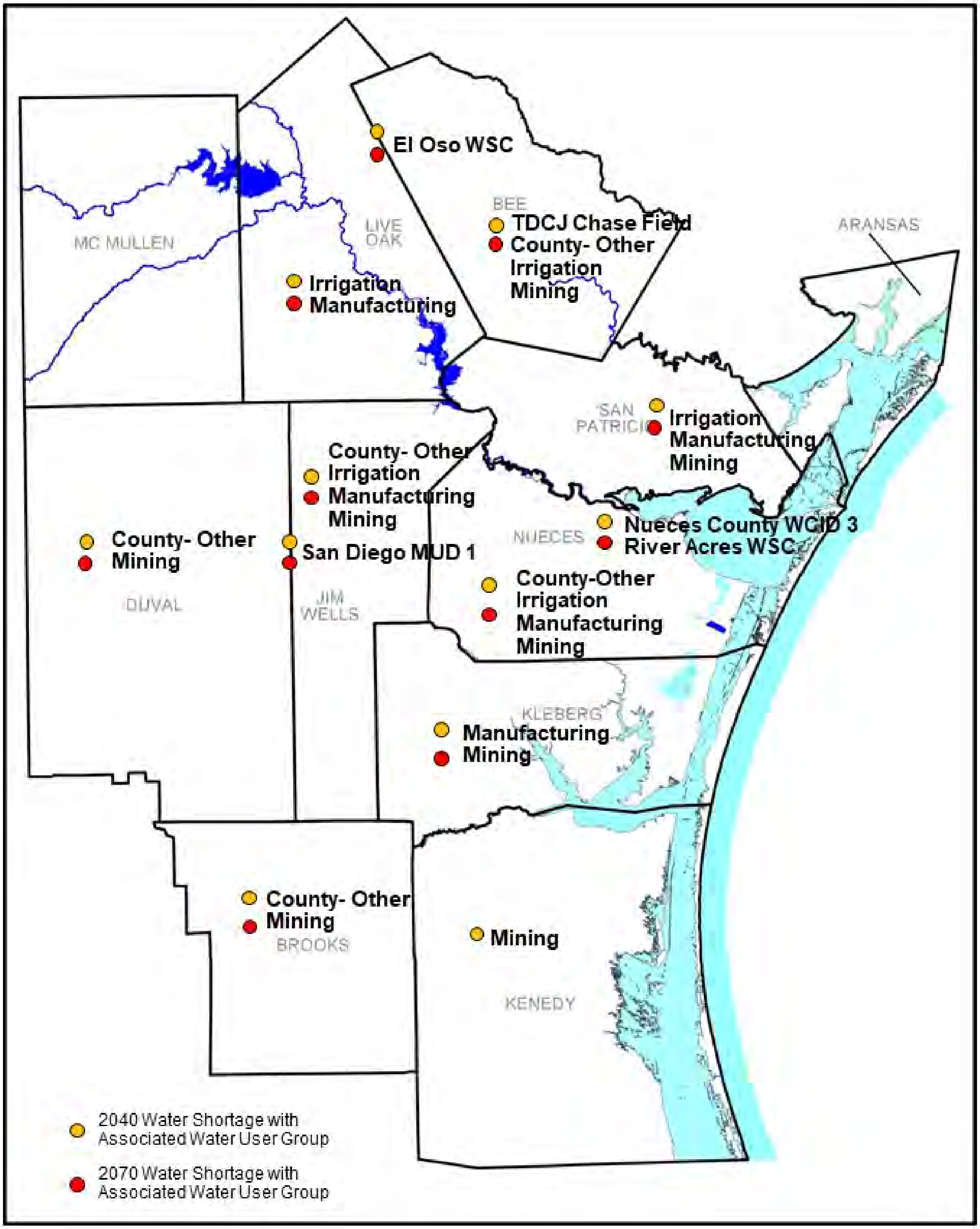


Figure ES.6.
Location and Type of Use for 2040 and 2070 Water Supply Needs

manufacturing and San Patricio County manufacturing. SPMWD is authorized to receive 53,486 ac-ft/yr of water from the City of Corpus Christi in 2020 and 73,800 ac-ft/yr after 2020, which would meet the demands of its customers and have a raw water surplus throughout the planning period. However, the City does not currently have the supply to provide the full contracted purchases after 2020, and therefore SPMWD shows increasing water supply shortages from 2030 through 2070. SPMWD's shortages are applied to San Patricio County manufacturing, and this shortage is included in the City's shortage total. STWA receives treated water supplies to meet the demands of its customers, consistent with the terms of the present contracts, and has no projected shortages. Nueces County WCID #3 receives supply through run-of-river water rights and is projected to have a shortage in all decades attributed to a lack of sufficient firm yield during drought of record conditions.

ES.6 Water Supply Strategies to Meet Needs

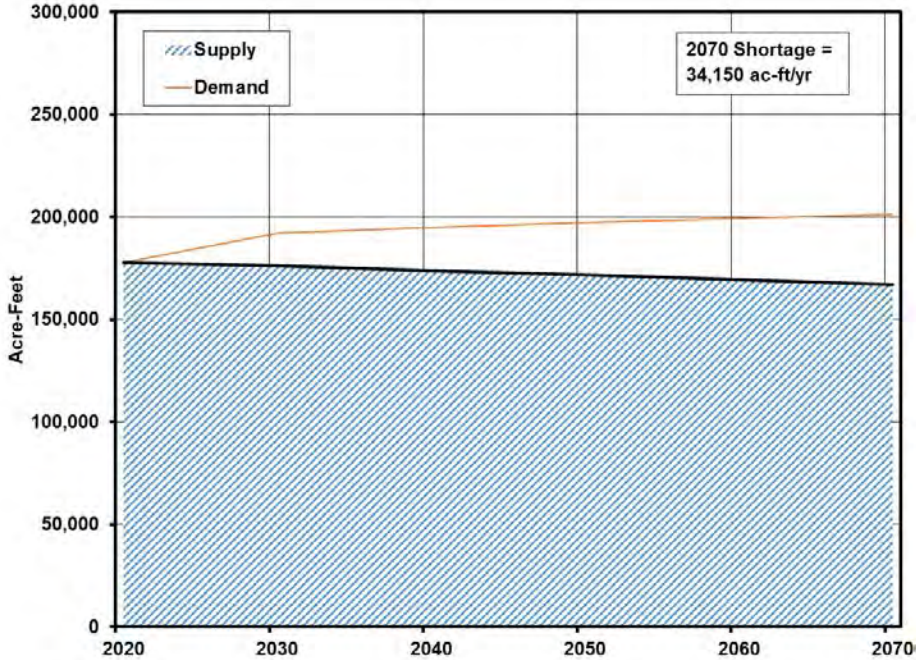
Numerous water management strategies were identified by the CBRWPG as potentially feasible to meet water supply shortages. Each strategy was evaluated and compared to criteria adopted by the CBRWPG. The Coastal Bend Regional Water Plan includes recommended water management strategies that emphasize water conservation and reuse; maximize utilization of available resources, water rights, and reservoirs; develop drought-tolerant supplies; engage the efficiency of conjunctive use of surface and groundwater; and limit depletion of storage in aquifers. The strategies identified as potentially feasible are tabulated in Table ES.7 and Table ES.8 Table ES.7 summarizes potential strategies for current Wholesale Water Providers, while Table ES.8 summarizes strategies for other service areas. Additionally, Figure ES.9 provides a graphical comparison of unit costs and quantities of water provided for selected strategies evaluated. Section 5D contains sections discussing each of these possible strategies in detail.

Table ES.9 summarizes findings and recommendations for every water user group, including those with projected water shortages. The table lists each municipality and water user group by county. Water demands are listed for years 2020, 2040, and 2070. Shortages are listed for years 2020, 2040, and 2070, along with recommended actions to meet these shortages.

The recommended water supply plans are presented by county in greater detail in Chapter 5B. Water management strategies recommended in the Coastal Bend Region could produce new supplies in excess of the projected regional need of 49,363 ac-ft in Year 2070. Supplies exceed shortages in case water growth patterns and demands exceed TWDB projections.

Table ES.10 summarizes those strategies that are recommended in the regional water plan. Total estimated project cost (in September 2018 dollars) for the recommended water management strategies for the Coastal Bend Region is $3.27 billion. Capital costs are included for all recommended water management strategies, except manufacturing and mining water conservation due to the high variability and site-specific nature of conservation programs. Five seawater desalination plants are recommended for Nueces and San Patricio County manufacturing and cumulative water supplies from recommended water management strategies far exceeds identified shortages. No alternative water management strategies are recommended as part of the planning process.

City of Corpus Christi Service Area
**Note: Does not include SPMWD and STWA*



San Patricio Municipal Water District Service Area

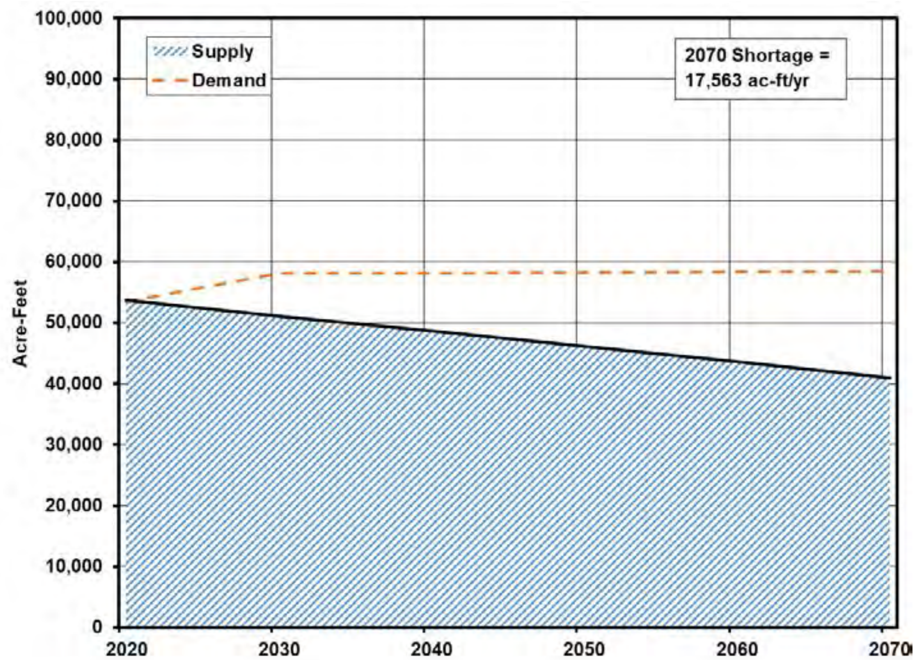
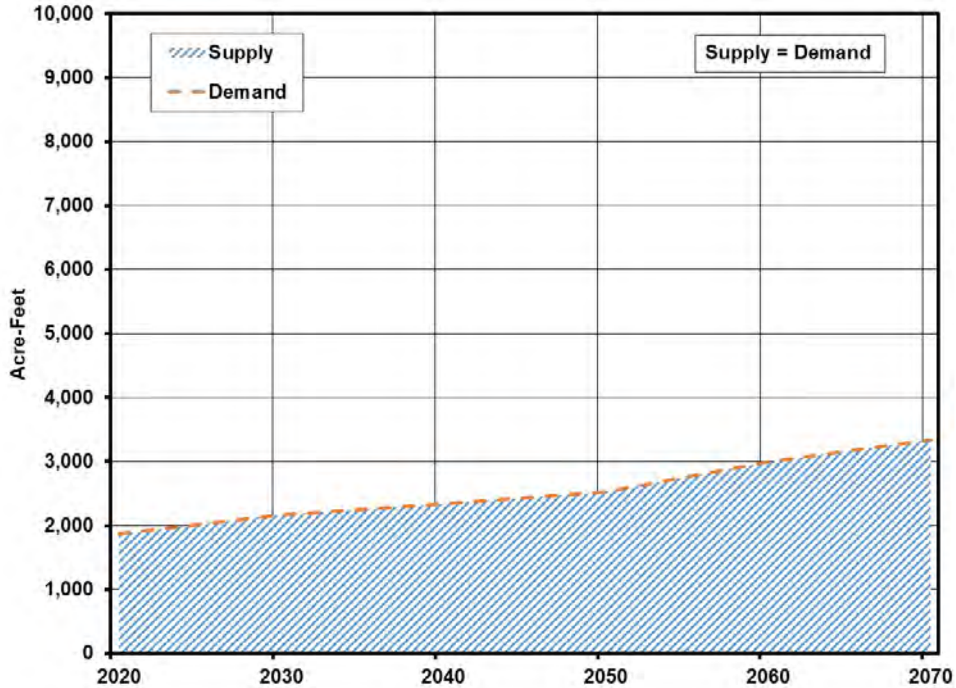


Figure ES.7.
Water Supply vs. Demand for Current Wholesale Water Providers Water Plan
(Page 1 of 2)

South Texas Water Authority Service Area



Nueces County WCID #3 Service Area

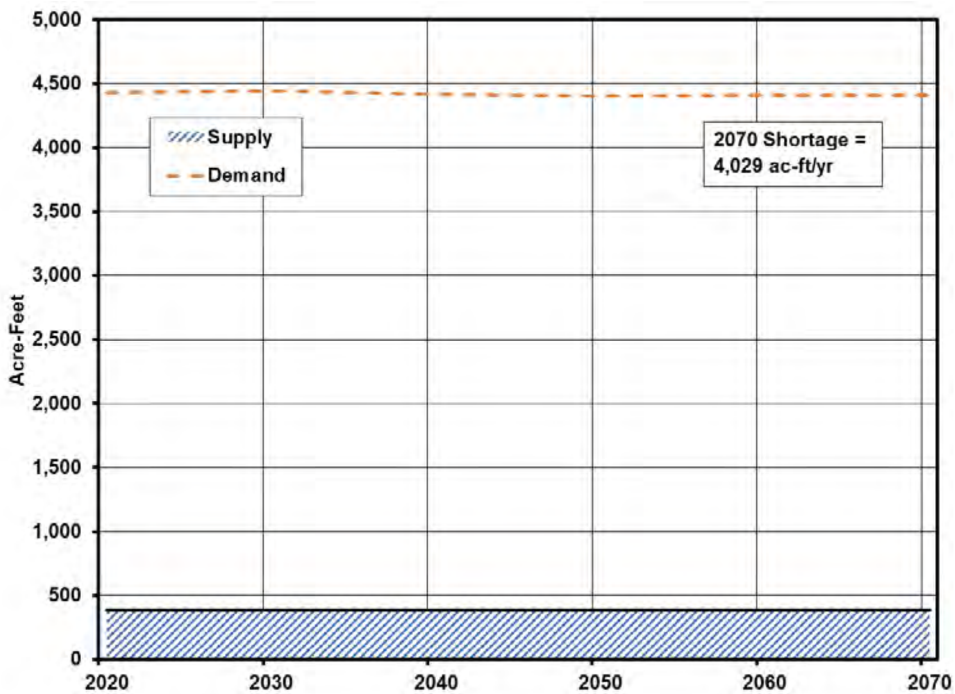


Figure ES.8.
Water Supply vs. Demand for Current Wholesale Water Providers Water Plan (Page 2 of 2).

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Table ES.7.
Potential Water Management Strategies to Meet Long-Term Needs for Current Wholesale Water Providers

WMS ID	Water Management Strategy	Additional Water Supply (ac-ft/yr)	Total Project Cost ($)	Annual Cost ($)	Unit Cost of Additional Treated Water ($ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5D.1	**Municipal Water Conservation**	up to 18,793	Up to $94,234,000 for region	Variable	$498 - $503	No change	Possible reduction in return flows to bay and estuary
5D.3	**Manufacturing Water Conservation**	up to 14,733	Highly variable	Highly variable	Variable	Variable. Depends on BMP.	Possible reduction in return flows to bay and estuary
5D.5	**Reuse**						
	Regional Industrial Wastewater Reuse Plan (6.47 MGD)	7,250	$137,834,000	$10,046,000	$1,386	Improves quality	Potential reduction of freshwater inflows to bay and estuary; construction and maintenance of pipeline corridors
	Regional Industrial Wastewater Reuse Plan (4.47 MGD)	5,010	$115,502,000	$8,475,000	$1,692	Improves quality	
5D.6	**Local Balancing Storage Reservoir**	4,058	$21,575,000	$1,641,000	$426	No Change	Construction and maintenance of pipeline corridors and terminal storage
5D.7	**City of Corpus Christi Aquifer Storage and Recovery**						
	Phase I (13 MGD)	14,573	$68,632,000 to $90,199,000	$6,979,000 to $8,836,000	$479 to $606	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
	Phase II (18 MGD)	20,178	$123,253,000 to $174,668,000	$12,189,000 to $16,383,000	$604 to $812	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
5D.8	**Gulf Coast Aquifer Supplies**						
	Evangeline/Laguna Groundwater Project (Raw)						
	Delivery Option 1- MAG constrained	24,873	$115,585,000	$22,210,000	$893	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 1- Future	28,486	$115,585,000	$24,446,000	$858	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 2- MAG constrained	24,873	$74,596,000	$18,492,000	$743	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 3- MAG constrained	24,873	$78,063,000	$19,119,000	$769	Slight degradation	Construction and maintenance of pipeline corridors
5D.9	**Groundwater Desalination**						
	Evangeline/Laguna Treated Groundwater Project						
	Delivery Option 1- MAG constrained	19,898	$190,416,000	$37,675,000	$1,893	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Delivery Option 1- Future	22,788	$190,416,000	$39,776,000	$1,745	Significant improvement	
	Delivery Option 2- MAG constrained	19,898	$155,431,000	$34,707,000	$1,744	Significant improvement	
	Delivery Option 3- MAG constrained	19,898	$157,550,000	$35,159,000	$1,767	Significant improvement	
5D.10	**Seawater Desalination**						
	City of Corpus Christi- Inner Harbor (10 MGD)	11,201	$236,693,000	$36,042,000	$3,218	Variable. Low to significant improvement.	Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
	City of Corpus Christi- Inner Harbor (30 MGD)	33,604	$562,779,000	$85,875,000	$2,555	Variable. Low to significant improvement.	
	City of Corpus Christi- La Quinta (20 MGD)	22,402	$420,372,000	$62,720,000	$2,800	Variable. Low to significant improvement.	
	City of Corpus Christi- La Quinta (40 MGD)	44,804	$768,475,000	$114,102,000	$2,547	Variable. Low to significant improvement.	
	Poseidon Regional Project at Ingleside (50 MGD)	56,044	$724,984,000	$123,638,000	$2,206	Variable. Low to significant improvement.	
	Poseidon Regional Project at Ingleside (100 MGD)	112,000	$1,280,848,000	$218,932,000	$1,955	Variable. Low to significant improvement.	
	Port of Corpus Christi Authority- Harbor Island (50 MGD)	56,044	$802,807,000	$130,167,000	$2,323	Variable. Low to significant improvement.	Threatened and endangered species habitat identified near project site. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay.
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	33,604	$457,732,000	$77,991,000	$2,321	Variable. Low to significant improvement.	Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
5D.11	**Regional Water Treatment Plant Facility Expansions- ON Stevens WTP**	32,030	$68,212,000	$6,266,000	$565	No Change	None

Table ES.8. Potential Water Management Strategies to Meet Long-Term Needs for Local Service Areas

WMS ID	Water Management Strategy	Water Supply (ac-ft/yr)	Total Project Cost ($)	Annual Cost ($)	Unit Cost of Treated Water ($ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5D.1	**Municipal Water Conservation**	up to 18,793	Variable, Regional Cost up to $94,234,000	Variable	$498 - $503	No change	Possible reduction in return flows to bay and estuary
5D.2	**Irrigation Water Conservation**	430	Variable, Regional Cost up to $12,111,317		$1,911 - $4,822	No change	None
5D.3	**Manufacturing Water Conservation**	up to 14,733	Highly variable	Highly variable	Variable	Variable. Depends on BMP. Low to significant improvement.	Possible reduction in return flows to bay and estuary
5D.4	**Mining Water Conservation**	up to 374	Highly variable	Highly variable	Variable	No change	Possible reduction in return flows to bay and estuary
5D.5	**Reuse**						
	City of Alice- Non-potable Reuse	897	$10,222,000	$1,300,000	$1,449	Improves quality	Reduction of freshwater inflows to intermittent, local streams. Possible reduction in return flows to bay and estuary; construction and maintenance of pipeline corridors
5D.8	**Gulf Coast Aquifer Supplies**						
	Bee County-Other (Municipal)	1,682	$4,943,000	$551,000	$328	No to low degradation	Minor Impacts
	El Oso WSC	94	$424,000	$52,000	$553	No to low degradation	Minor Impacts
	Bee County- Irrigation	352	$1,166,000	$97,000	$276	No to low degradation	Minor Impacts
	Bee County- Mining	197	$622,000	$51,000	$259	No to low degradation	Minor Impacts
	TDCJ Chase Field	208	$703,000	$84,000	$404	No to low degradation	Minor Impacts
	Brooks County-Other (Municipal)	309	$1,207,000	$133,000	$430	No to low degradation	Minor Impacts
	Brooks County- Mining	182	$615,000	$53,000	$291	No to low degradation	Minor Impacts
	Duval County-Other (Municipal)	516	$2,109,000	$228,000	$442	No to low degradation	Minor Impacts
	Duval County- Mining	768	$3,228,000	$274,000	$357	No to low degradation	Minor Impacts
	Duval County- San Diego MUD 1	417	$1,856,000	$189,000	$453	No to low degradation	Minor Impacts
	Jim Wells County-Other (Municipal)	2,650	$10,704,000	$1,039,000	$392	No to low degradation	Minor Impacts
	Jim Wells County- Irrigation	333	$753,000	$61,000	$183	No to low degradation	Minor Impacts
	Jim Wells County- Manufacturing	16	$129,000	$11,000	$688	No to low degradation	Minor Impacts
	Jim Wells County- Mining	55	$202,000	$17,000	$309	No to low degradation	Minor Impacts
	Kenedy County- Mining	63	$469,000	$37,000	$587	No to low degradation	Minor Impacts
	Kleberg County- Manufacturing	247	$852,000	$68,000	$275	No to low degradation	Minor Impacts
	Kleberg County- Mining	142	$638,000	$51,000	$359	No to low degradation	Minor Impacts
	Live Oak County- Irrigation	534	$917,000	$76,000	$142	No to low degradation	Minor Impacts
	Live Oak County- Manufacturing	28	$188,000	$14,000	$500	No to low degradation	Minor Impacts
	Nueces County- Other (Municipal)	1,435	$4,514,000	$462,000	$322	No to low degradation	Minor Impacts
	Nueces County- Irrigation	51	$319,000	$24,000	$471	No to low degradation	Minor Impacts
	Nueces County-Mining	1,127	$2,200,000	$178,000	$158	No to low degradation	Minor Impacts
	San Patricio County- Irrigation	204	$420,000	$33,000	$162	No to low degradation	Minor Impacts
	San Patricio County- Mining	398	$1,141,000	$91,000	$229	No to low degradation	Minor Impacts
5D.9	**Groundwater Desalination**						
	City of Alice	3,360	$23,983,000	$3,932,000	$1,170	Variable. Low to significant improvement.	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.

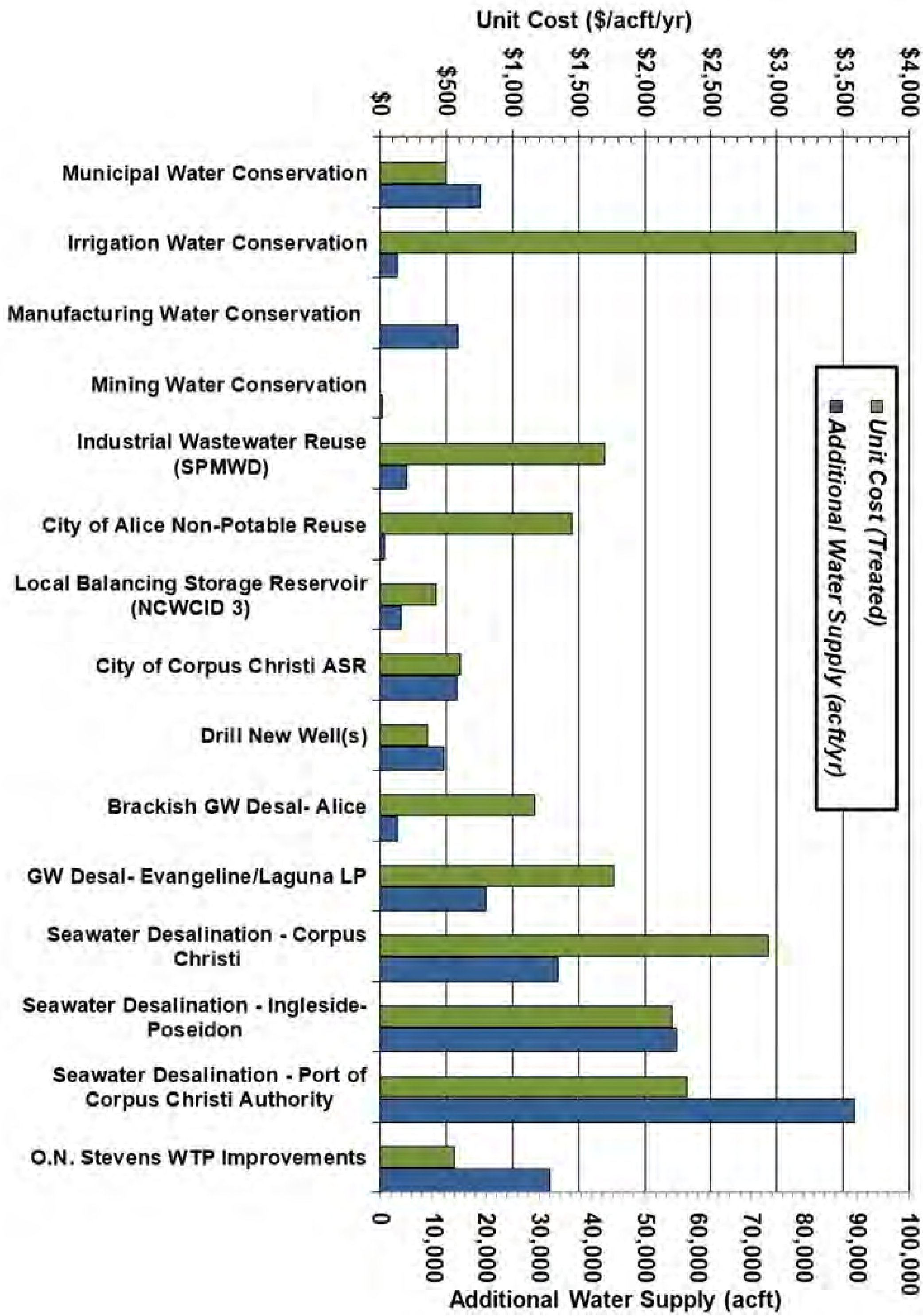


Figure ES.9.
Comparison of Unit Costs and Water Supply Quantities for Potential Water Management Strategies for Coastal Bend

Table ES.9. Water Plan Summary for Coastal Bend Region

County/Water User Group	Demand (ac-ft)			Need (Shortage) (ac-ft)			Recommended Management Strategies to Meet Need (Shortage)
	2020	2040	2070	2020	2040	2070	
Aransas County	**See Section 4A.3.1**						**See Section 5B.2**
Aransas Pass (P)	132	127	126	none	none	none	
Rockport	3,462	3,410	3,398	none	none	none	Additional municipal water conservation
County-Other	491	462	455	none	none	none	
Manufacturing	0	0	0	none	none	none	
Steam-Electric	0	0	0	none	none	none	
Mining	10	5	5	none	none	none	
Irrigation	0	0	0	none	none	none	
Livestock	56	56	56	none	none	none	
Bee County	**See Section 4A.3.2**						**See Section 5B.3**
Beeville	3,336	3,394	3,376	none	none	none	Additional municipal water conservation
El Oso WSC (P)	100	101	96	(94)	(94)	(90)	Additional municipal water conservation; Gulf Coast Aquifer Supplies
Pettus MUD	104	104	103	none	none	none	
TDCJ Chase Field	1,024	1,055	1,050	(177)	(208)	(203)	Additional municipal water conservation; Gulf Coast Aquifer Supplies
County-Other	1,875	1,893	1,872	(1,657)	(1,675)	(1,654)	Gulf Coast Aquifer Supplies
Manufacturing	0	0	0	none	none	none	
Steam-Electric	472	428	318	none	none	none	
Mining	4,425	4,425	4,425	(197)	(158)	(62)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	834	834	834	(352)	(352)	(352)	Irrigation water conservation; Gulf Coast Aquifer Supplies
Livestock	3,336	3,394	3,376	none	none	none	
Brooks County	**See Section 4A.3.3**						**See Section 5B.4**
Falfurrias	1,639	1,703	1,852	none	none	none	Additional municipal water conservation
County-Other	224	269	341	(192)	(237)	(309)	Gulf Coast Aquifer Supplies
Manufacturing	1	1	1	none	none	none	
Steam-Electric	0	0	0	none	none	none	
Mining	357	340	298	(179)	(162)	(120)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	1,161	1,161	1,161	none	none	none	
Livestock	463	463	463	none	none	none	
Duval County	**See Section 4A.3.4**						**See Section 5B.5**
Duval County CRD	260	271	291	none	none	none	
Freer WCID	687	733	794	none	none	none	Additional municipal water conservation
San Diego MUD 1 (P)	747	797	876	(288)	(338)	(417)	Additional municipal water conservation; Gulf Coast Aquifer Supplies
County-Other	477	490	516	(477)	(490)	(516)	Gulf Coast Aquifer Supplies
Manufacturing	0	0	0	none	none	none	
Steam-Electric	0	0	0	none	none	none	
Mining	1,388	1,352	1,104	(712)	(676)	(428)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	4,042	4,042	4,042	none	none	none	
Livestock	640	640	640	none	none	none	

County/Water User Group	Demand (ac-ft)			Need (Shortage) (ac-ft)			Recommended Management Strategies to Meet Need (Shortage)
	2020	2040	2070	2020	2040	2070	
Jim Wells County	**See Section 4A.3.5**						**See Section 5B.6**
Alice	4,494	4,978	5,812	none	none	none	Additional municipal water conservation; Brackish groundwater desalination; Non-Potable Reuse
	131	151	178	none	none	none	
Orange Grove	476	534	625	none	none	none	Additional municipal water conservation
Premont	709	791	928	none	none	none	Additional municipal water conservation
San Diego MUD 1 (P)	174	186	204	none	none	none	Additional municipal water conservation
County-Other	2,095	2,303	2,687	(2,058)	(2,266)	(2,650)	Gulf Coast Aquifer Supplies
Manufacturing	79	95	95	none	(16)	(16)	Manufacturing water conservation; Gulf Coast Aquifer Supplies
Steam-Electric	0	0	0	none	none	none	
Mining	71	55	17	(52)	(36)	(1)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	1,913	1,913	1,913	(333)	(333)	(333)	Irrigation water conservation; Gulf Coast Aquifer Supplies
Livestock	902	902	902	none	none	none	
Kenedy County	**See Section 4A.3.6**						**See Section 5B.7**
County-Other	244	262	263	none	none	none	Additional municipal water conservation
Manufacturing	0	0	0	none	none	none	
Steam-Electric	0	0	0	none	none	none	
Mining	118	92	27	(58)	(32)	none	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	0	0	0	none	none	none	
Livestock	735	735	735	none	none	none	
Kleberg County	**See Section 4A.3.7**						**See Section 5B.8**
Baffin Bay WSC	237	268	320	none	none	none	
Kingsville	4,205	4,706	5,599	none	none	none	
Naval Air Station Kingsville	256	303	366	none	none	none	Additional municipal water conservation
Ricardo WSC	340	382	454	none	none	none	
Riviera Water System	114	129	153	none	none	none	
County-Other	257	290	349	none	none	none	Additional municipal water conservation
Manufacturing	1,809	2,056	2,056	none	(247)	(247)	Manufacturing water conservation; Gulf Coast Aquifer Supplies
Steam-Electric	0	0	0	none	none	none	
Mining	357	340	298	(139)	(122)	(80)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	850	850	850	none	none	none	
Livestock	673	673	673	none	none	none	

County/Water User Group	Demand (ac-ft)			Need (Shortage) (ac-ft)			Recommended Management Strategies to Meet Need (Shortage)
	2020	2040	2070	2020	2040	2070	
Live Oak County	**See Section 4A.3.8**						**See Section 5B.9**
El Oso WSC (P)	178	171	160	(94)	(94)	(90)	Additional municipal water conservation; Gulf Coast Aquifer Supplies
George West	435	414	410	none	none	none	Additional municipal water conservation
McCoy WSC	21	20	20	none	none	none	
Three Rivers	545	518	511	none	none	none	Additional municipal water conservation
County-Other	637	610	602	none	none	none	
Manufacturing	2,274	2,493	2,493	none	(28)	(28)	Manufacturing water conservation; Gulf Coast Aquifer Supplies
Steam-Electric	0	0	0	none	none	none	
Mining	814	907	332	none	none	none	
Irrigation	1,630	1,630	1,630	(343)	(534)	(534)	Irrigation water conservation; Gulf Coast Aquifer Supplies
Livestock	740	740	740	none	none	none	
McMullen County	**See Section 4A.3.9**						**See Section 5B.10**
County-Other	97	91	89	none	none	none	
Manufacturing	219	249	249	none	none	none	
Steam-Electric	0	0	0	none	none	none	
Mining	4,268	4,754	1,305	none	none	none	
Irrigation	0	0	0	none	none	none	
Livestock	335	335	335	none	none	none	
Nueces County	**See Section 4A.3.10**						**See Section 5B.11**
Aransas Pass (P)	2	2	2	none	none	none	
Bishop	593	645	681	none	none	none	Additional municipal water conservation
Corpus Christi	64,110	70,493	74,240	none	none	none	Additional municipal water conservation; Seawater desalination- Corpus Christi Inner Harbor
Corpus Christi NAS	1,085	1,237	1,315	none	none	none	Additional municipal water conservation
Driscoll	105	112	117	none	none	none	
Nueces County WCID 3	4,004	3,952	3,928	(3,812)	(3,760)	(3,736)	Additional municipal water conservation; Local balancing storage
Nueces County WCID 4	2,465	2,782	2,951	none	none	none	Additional municipal water conservation
Nueces WSC	457	668	999	none	none	none	Additional municipal water conservation
River Acres WSC	426	462	485	(234)	(270)	(293)	Local balancing storage
Violet WSC	186	196	204	none	none	none	
County-Other	1,475	1,695	1,667	(1,245)	(1,430)	(1,364)	Gulf Coast Aquifer Supplies
Manufacturing	45,411	50,363	50,363	none	(11,685)	(16,587)	Manufacturing water conservation; O.N. Stevens WTP improvements; ASR; Evangeline/Laguna LP Brackish Groundwater Desalination; and Seawater desalination- Corpus Christi Inner Harbor; and Seawater desalination- PCCA Harbor Island
Steam-Electric	2,077	2,077	2,077	none	none	none	
Mining	724	947	1,260	(629)	(836)	(1,127)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	1,540	1,540	1,540	(51)	(51)	(51)	Irrigation water conservation; Gulf Coast Aquifer Supplies
Livestock	291	291	291	none	none	none	

County/Water User Group	Demand (ac-ft)			Need (Shortage) (ac-ft)			Recommended Management Strategies to Meet Need (Shortage)
	2020	2040	2070	2020	2040	2070	
San Patricio County	**See Section 4A.3.11**						**See Section 5B.12**
Aransas Pass (P)	1,370	1,392	1,425	none	none	none	
Gregory	339	348	360	none	none	none	Additional municipal water conservation
Ingleside	1,013	1,023	1,044	none	none	none	
Mathis	653	655	673	none	none	none	
Odem	395	401	411	none	none	none	
Portland	3,389	3,477	3,569	none	none	none	
Rincon WSC	368	381	392	none	none	none	
Sinton	1,345	1,396	1,438	none	none	none	Additional municipal water conservation
Taft	540	545	563	none	none	none	
County-Other	843	877	908	none	none	none	
Manufacturing	38,841	43,223	43,223	190	(9,533)	(17,563)	Manufacturing water conservation; O.N. Stevens WTP improvements; Regional industrial wastewater reuse plan; Evangeline/Laguna LP Brackish Groundwater Desalination; Seawater desalination- Corpus Christi- La Quinta; Seawater desalination- Ingleside-Poseidon; Seawater desalination- PCCA La Quinta; Seawater desalination- PCCA Harbor Island
Steam-Electric	1,919	1,919	1,919	none	none	none	
Mining	372	440	533	(237)	(305)	(398)	Mining water conservation; Gulf Coast Aquifer Supplies
Irrigation	14,645	14,645	14,645	(204)	(204)	(204)	Irrigation water conservation; Gulf Coast Aquifer
Livestock	396	396	396	none	none	none	
Total Needs by Water User Type							
Municipal	115,366	124,655	132,248	(10,234)	(10,768)	(11,232)	
Manufacturing	88,634	98,480	98,480	190	(21,509)	(34,441)	
Steam-Electric	3,996	3,996	3,996	0	0	0	
Mining	8,951	9,660	5,497	(2,203)	(2,327)	(2,216)	
Irrigation	30,206	30,206	30,206	(1,283)	(1,474)	(1,474)	
Livestock	6,065	6,065	6,065	0	0	0	
Region N Total	**253,218**	**273,062**	**276,492**	**(13,530)**	**(36,078)**	**(49,363)**	

Note: (P) = Partial listing – water user group in multiple counties.

Table ES.10.
Summary of Recommended Water Management Strategies in the Coastal Bend Region

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.1	**Municipal Water Conservation**	***Variable, Regional Cost up to $94,234,000***	***$498 - $503***	***$498 - $503***	***0***	***7,341***	***14,689***	***16,399***	***17,707***	***18,793***
	Rockport	$1,751,000	$498	$498	0	270	353	327	321	321
	Beeville	$3,991,000	$498	$498	0	254	502	757	806	806
	El Oso WSC	$111,000	$500	$500	0	7	14	22	19	19
	TDCJ Chase Field	$1,947,000	$500	$500	0	85	167	247	322	391
	Falfurrias	$3,423,000	$500	$500	0	132	266	406	546	688
	Freer WCID	$1,070,000	$500	$500	0	54	110	170	211	215
	San Diego MUD 1	$435,000	$500	$500	0	55	88	83	84	87
	Alice	$4,862,000	$498	$498	0	345	725	899	938	981
	Orange Grove	$1,153,000	$500	$500	0	40	83	131	181	232
	Premont	$1,504,000	$500	$500	0	58	120	194	268	302
	San Diego MUD 1	$103,000	$500	$500	0	13	21	19	19	20
	County-Other, Kenedy	$503,000	$500	$500	0	23	45	65	84	101
	County-Other, Kleberg	$51,000	$500	$500	0	10	6	6	6	6
	Naval Air Station Kingsville	$716,000	$500	$500	0	26	54	84	114	144
	El Oso WSC	$186,000	$500	$500	0	13	25	37	30	30
	George West	$207,000	$500	$500	0	30	42	39	38	38
	Three Rivers	$183,000	$500	$500	0	37	24	18	17	17
	Bishop	$213,000	$500	$500	0	43	26	23	22	22
	Corpus Christi	$53,940,000	$503	$503	0	5,028	10,439	10,550	10,648	10,779
	Corpus Christi Naval Air Station	$2,560,000	$500	$500	0	109	220	325	423	515
	Nueces County WCID 3	$7,316,000	$498	$498	0	328	638	936	1,219	1,477
	Nueces County WCID 4	$5,640,000	$500	$500	0	233	473	706	929	1,134
	Nueces WSC	$177,000	$500	$500	0	31	28	29	30	35
	Gregory	$55,000	$500	$500	0	11	6	6	4	4
	Sinton	$2,137,000	$500	$500	0	106	211	319	427	430

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.2	**Irrigation Water Conservation**	***Variable, Regional Cost up to $12,111,317***	***$1,911 - $4,822***	***$1,911 - $4,822***	***561***	***1,122***	***1,683***	***2,244***	***2,806***	***3,367***
	Bee County	$3,041,704	$4,822	$4,822	105	210	315	421	526	631
	Jim Wells County	$548,471	$1,911	$1,911	48	96	143	191	239	287
	Live Oak County	$676,687	$2,768	$2,768	41	82	122	163	204	245
	Nueces County	$15,196	$1,986	$1,986	1	3	4	5	6	8
	San Patricio County	$7,829,259	$3,564	$3,564	366	732	1,098	1,465	1,831	2,197
5D.3	**Manufacturing Water Conservation**				***2,210***	***4,912***	***7,367***	***9,823***	***12,279***	***14,735***
	Jim Wells County	N/A	N/A	N/A	2	5	7	10	12	14
	Kleberg County	N/A	N/A	N/A	45	103	154	206	257	308
	Live Oak County	N/A	N/A	N/A	57	125	187	249	312	374
	Nueces County	N/A	N/A	N/A	1,135	2,518	3,777	5,036	6,295	7,554
	San Patricio County	N/A	N/A	N/A	971	2,161	3,242	4,322	5,403	6,483
5D.4	**Mining Water Conservation**				***76***	***157***	***221***	***273***	***323***	***374***
	Bee County	N/A	N/A	N/A	10	20	28	33	37	42
	Brooks County	N/A	N/A	N/A	9	18	26	32	39	45
	Duval County	N/A	N/A	N/A	35	72	101	124	146	166
	Jim Wells County	N/A	N/A	N/A	2	4	4	4	3	3
	Kenedy County	N/A	N/A	N/A	3	6	7	7	5	4
	Kleberg County	N/A	N/A	N/A	9	18	26	32	39	45
	Nueces County	N/A	N/A	N/A	1	2	3	4	6	8
	San Patricio County	N/A	N/A	N/A	7	17	26	36	49	63
5D.5	**Reuse**									
	Regional Industrial Wastewater Reuse Plan (4.47 MGD)	$115,502,000	$1,692	$1,692	0	5,010	5,010	5,010	5,010	5,010
	City of Alice- Non-potable Reuse	$10,222,000	$1,449	$648	0	897	897	897	897	897
5D.6	**Local Balancing Storage Reservoir**	**$21,575,000**	**$426**	**$98**	**4,058**	**4,058**	**4,058**	**4,058**	**4,058**	**4,058**
5D.7	**City of Corpus Christi Aquifer Storage and Recovery**									
	Phase I (13 MGD)	$68,632,000 to $90,199,000	$479 to $606	$148 to $171	0	14,573	14,573	14,573	14,573	14,573
5D.8	**Gulf Coast Aquifer Supplies**									
	Bee County-Other (Municipal)	$4,943,000	$328	$121	1,682	1,682	1,682	1,682	1,682	1,682

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
	El Oso WSC	$424,000	$553	$234	94	94	94	94	94	94
	Bee County- Irrigation	$1,166,000	$276	$43	352	352	352	352	352	352
	Bee County- Mining	$622,000	$259	$36	197	197	197	197	197	197
	TDCJ Chase Field	$703,000	$404	$168	208	208	208	208	208	208
	Brooks County-Other (Municipal)	$1,207,000	$430	$155	309	309	309	309	309	309
	Brooks County- Mining	$615,000	$291	$55	182	182	182	182	182	182
	Duval County-Other (Municipal)	$2,109,000	$442	$155	516	516	516	516	516	516
	Duval County- Mining	$3,228,000	$357	$61	768	768	768	768	768	768
	Duval County- San Diego MUD 1	$1,856,000	$453	$139	417	417	417	417	417	417
	Jim Wells County-Other (Municipal)	$10,704,000	$392	$108	2,650	2,650	2,650	2,650	2,650	2,650
	Jim Wells County- Irrigation	$753,000	$183	$24	333	333	333	333	333	333
	Jim Wells County- Manufacturing	$129,000	$688	$125	0	16	16	16	16	16
	Jim Wells County- Mining	$202,000	$309	$55	55	55	55	55	55	55
	Kenedy County- Mining	$469,000	$587	$63	63	63	63	63	63	63
	Kleberg County- Manufacturing	$852,000	$275	$32	247	247	247	247	247	247
	Kleberg County- Mining	$638,000	$359	$42	142	142	142	142	142	142
	Live Oak County- Irrigation	$917,000	$142	$21	534	534	534	534	534	534
	Live Oak County- Manufacturing	$188,000	$500	$36	28	28	28	28	28	28
	Nueces County- Other (Municipal)	$4,514,000	$322	$100	1,435	1,435	1,435	1,435	1,435	1,435
	Nueces County- Irrigation	$319,000	$471	$39	51	51	51	51	51	51
	Nueces County-Mining	$2,200,000	$158	$20	1,127	1,127	1,127	1,127	1,127	1,127
	San Patricio County- Irrigation	$420,000	$162	$15	204	204	204	204	204	204
	San Patricio County- Mining	$1,141,000	$229	$28	398	398	398	398	398	398
5D.9	**Groundwater Desalination**									
	City of Alice	$23,983,000	$1,170	$668	3,360	3,360	3,360	3,360	3,360	3,360
	Evangeline/Laguna Treated Groundwater									
	Delivery Option 3- MAG constrained	$157,550,000	$1,767	$1,150	0	19,898	19,898	22,788	22,788	22,788
5D.10	**Seawater Desalination**									
	City of Corpus Christi- Inner Harbor (10 MGD)	$236,693,000	$3,218	$1,731	0	11,201	11,201	11,201	11,201	11,201
	City of Corpus Christi- La Quinta (20 MGD)	$420,372,000	$2,800	$1,479	0	22,402	22,402	22,402	22,402	22,402
	Poseidon Regional Seawater Desalination Project at Ingleside (50 MGD)	$724,984,000	$2,206	$1,296	0	56,044	56,044	56,044	56,044	56,044
	Port of Corpus Christi Authority- Harbor Island (50 MGD)	$802,807,000	$2,323	$1,315	0	56,044	56,044	56,044	56,044	56,044

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	$457,732,000	$2,321	$1,362	0	33,604	33,604	33,604	33,604	33,604
5D.11	**Regional Water Treatment Plant Facility Expansions- ON Stevens WTP**	**$68,212,000**	**$565**	**$415**	**32,030**	**32,030**	**32,030**	**32,030**	**32,030**	**32,030**

Future projects involving authorization from either the TCEQ and/or TWDB, which are not specifically addressed in the plan, are considered to be consistent under the following circumstances:

- The CBRWPG considers projects that do not involve the development of or connection to a new water source to be consistent with the regional water plan even though not specifically recommended in the plan.
- TCEQ often considers surface water rights applications for small amounts of water, some are temporary, and some are even non-consumptive. Because most of the surface waters of the Nueces River Basin are appropriated to the City of Corpus Christi and others, any new water rights application for consumptive surface water use from this Basin will need to protect the existing water rights or provide appropriate mitigation to existing water right owners. Throughout the Coastal Bend Region, the types of small projects that may arise are unpredictable. The CBRWPG is of the opinion that each project should be considered by the TWDB and TCEQ on its merits, and that the Legislature provided appropriate language for each agency to address accordingly.

  (Note: The provision related to TCEQ is found in TWC §11.134. It provides that the Commission shall grant an application to appropriate surface water, including amendments, only if the proposed appropriator addresses a water supply need in a manner consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant. For TWDB funding, Texas Water Code §16.053(j) states that after January 5, 2002, TWDB may provide financial assistance to a water supply project only after the Board determines that the needs to be addressed by the project will be addressed in a manner that is consistent with that appropriate regional water plan. The TWDB may waive this provision if conditions warrant.)

ES.7 Social and Economic Impacts of Not Meeting Projected Water Needs

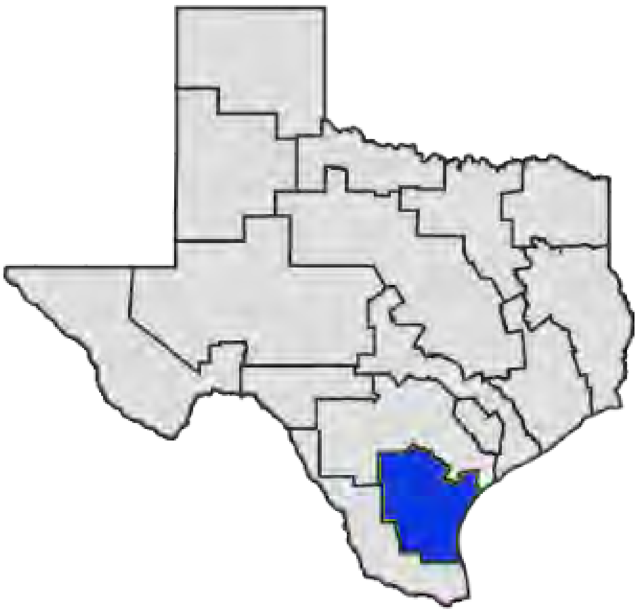
At the request of the CBRWPG, the TWDB[5] conducted a socioeconomic impact analysis of projected water shortages for the Region N area. The TWDB presented their findings at the November 14, 2019 CBRWPG meeting. The analysis represents a snapshot of socioeconomic impacts that may occur for a single year repeat of the DOR assuming no new water supply strategies are developed. The TWDB reported that Region N generated more than $31 billion in gross domestic product (GDP) in 2018 and supported roughly 328,000 jobs in 2016.

In Region N, the TWDB's socioeconomic impact report estimated that not meeting identified water needs in Region N would result in a combined lost income of approximately $732M and increasing to $6.9B in 2070. The region would also lose approximately 6,000 jobs in 2020 and 48,000 jobs by 2070 if the needs were left unmet. The TWDB's Socioeconomic Impacts report is included in Appendix B.

ES.8 Unmet Water Needs

There are no identified water needs that remain unmet for the 2021 Regional Water Plan.

[5] TWDB, Socioeconomic Impacts of Projected Water Shortages for the Coastal Bend (Region N) Regional Water Planning Area, November 2019.



1

Planning Area Description

[31 TAC §357.30]

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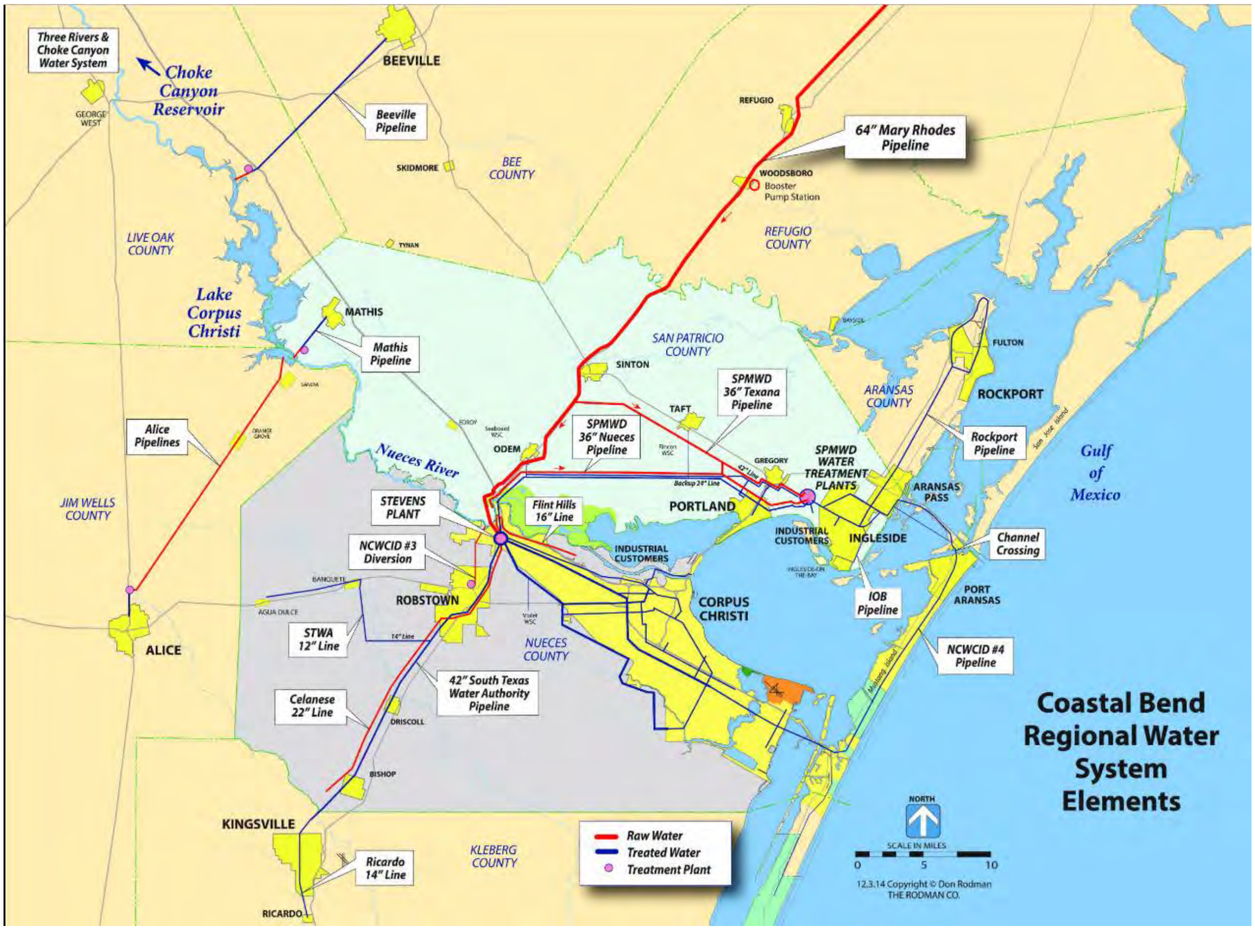
Chapter 1: Planning Area Description

The area represented by the Coastal Bend Regional Water Planning Group ("Region N" or "Coastal Bend Region") includes the following 11 counties: Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio. Most of the water supplies for the region are provided from surface water from the regional Choke Canyon/Lake Corpus Christi/Lake Texana/Mary Rhodes Pipeline Phase II system through the City of Corpus Christi or customer contracts (Figure 1.1), while others rely on groundwater supplies. Surface water supply relationships are discussed in greater detail in Chapter 3.



Source: City of Corpus Christi, https://www.cctexas.com/sites/default/files/wat-coastal-bend-regional-water-system.jpg

Figure 1.1.
Coastal Bend Regional Water System

1.1 Social and Economic Aspects of the Coastal Bend Region

According to estimates provided by the Texas Water Development Board (TWDB), the historical population of Region N grew from 505,224 in 2010 to 529,207 in 2015, representing an approximate 1% annual growth each year. In 2020, the population of the Coastal Bend Region is estimated to be 614,790.

The regional average per capita income in 2017 was $40,987, ranging from $27,543 in Bee County to $68,178 in McMullen County.[1] The Corpus Christi Metropolitan Statistical Area (MSA), consisting of Aransas, Nueces, and San Patricio Counties, accounts for 81 percent of the Coastal Bend Region's population and 80 percent of the total personal income. In 2017, the total personal income in the Coastal Bend Region was nearly $23.8 billion (Figure 1.2).

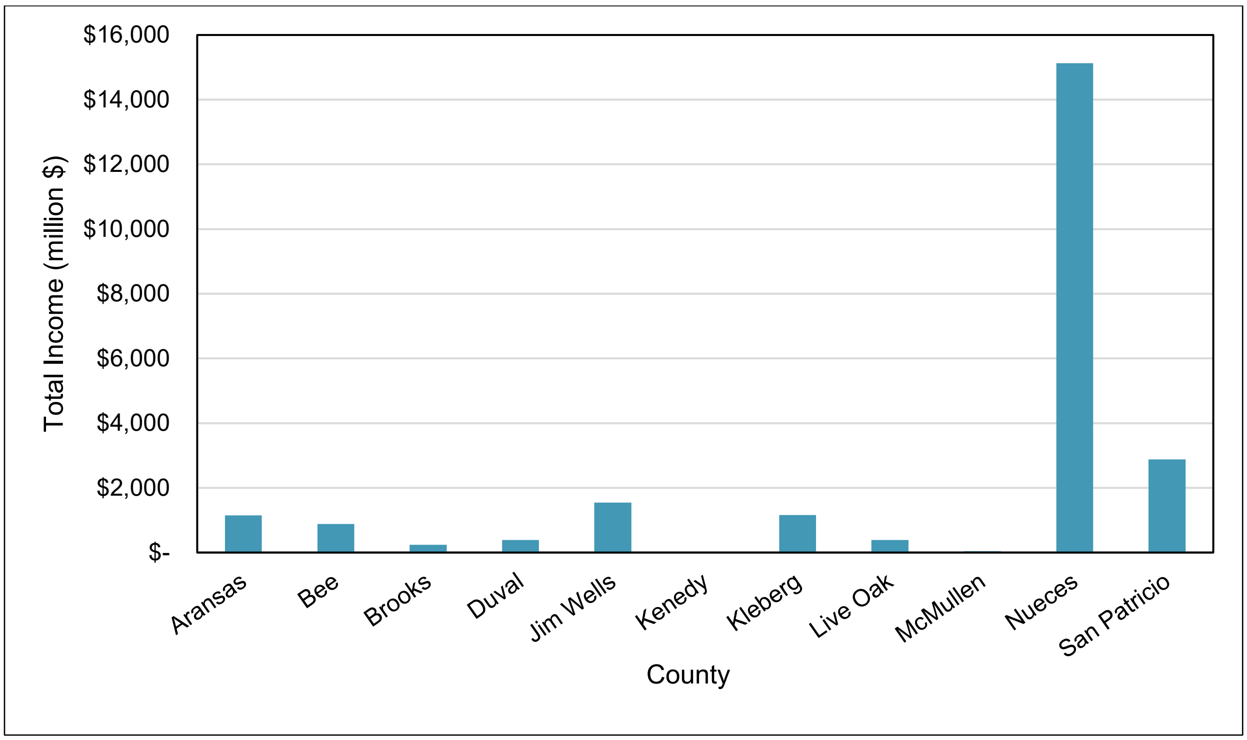


Figure 1.2.
Total Personal Income (Earnings) in 2017 by County

[1] U.S. Department of Commerce Bureau of Economic Analysis, Regional Economic Information System (REIS) Database, 2017.

The primary economic activities within the Coastal Bend Region include transportation and warehousing, oil and gas extraction and mining services, manufacturing, agriculture, forestry, fishing and hunting. In 2017, industries employed 192,089 people in the Coastal Bend Region with annual compensation to employees of over $7.8 billion (Figure 1.3 and Figure 1.4).[2] The service industries sector had the biggest economic impact in 2017, with a total compensation to employees of $2.69 billion (Figure 1.3). The service industries sector includes information, public administration, educational, health care, social services businesses, finance and insurance, and real estate. In 2017, 22% of the local workforce was employed by this sector (Figure 1.4).

The retail/wholesale trade sector is also a large contributor to the local economy. In 2017, 18% of the local workforce was employed by this sector, receiving total compensation of $600 million (Figure 1.3 and Figure 1.4). Oil and gas extraction, manufacturing, and construction activities employee over 39,000 people within the region and general annual compensation to employees of nearly $1.24 billion (Figure 1.3 and Figure 1.4).

Agriculture, forestry, fishing, and hunting is another industry that adds to the economic value of the Coastal Bend Region, as discussed in Chapter 1.5.

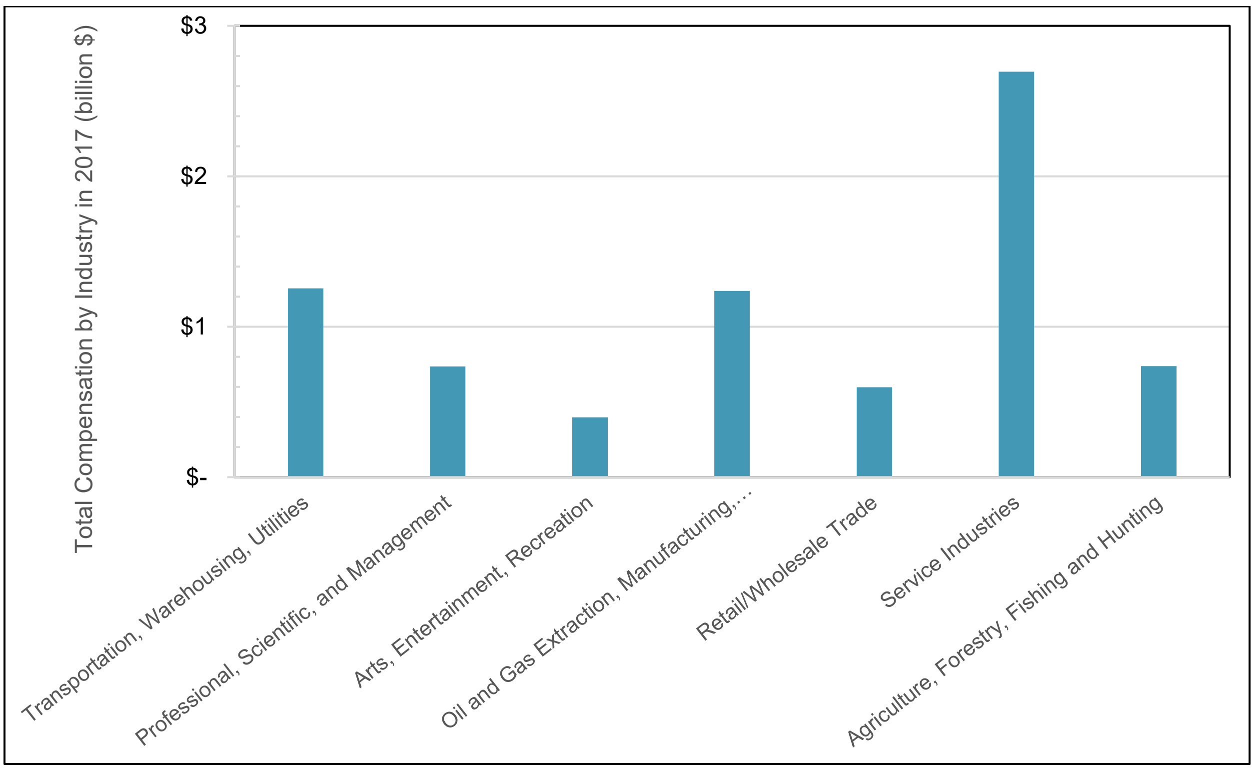


Figure 1.3.
Total Personal Income (Earnings) in 2017 by County

[2] 2017 United States Census Bureau, 2017 Economic Annual Survey County Business Patterns, CB1700CBP, November 2019.

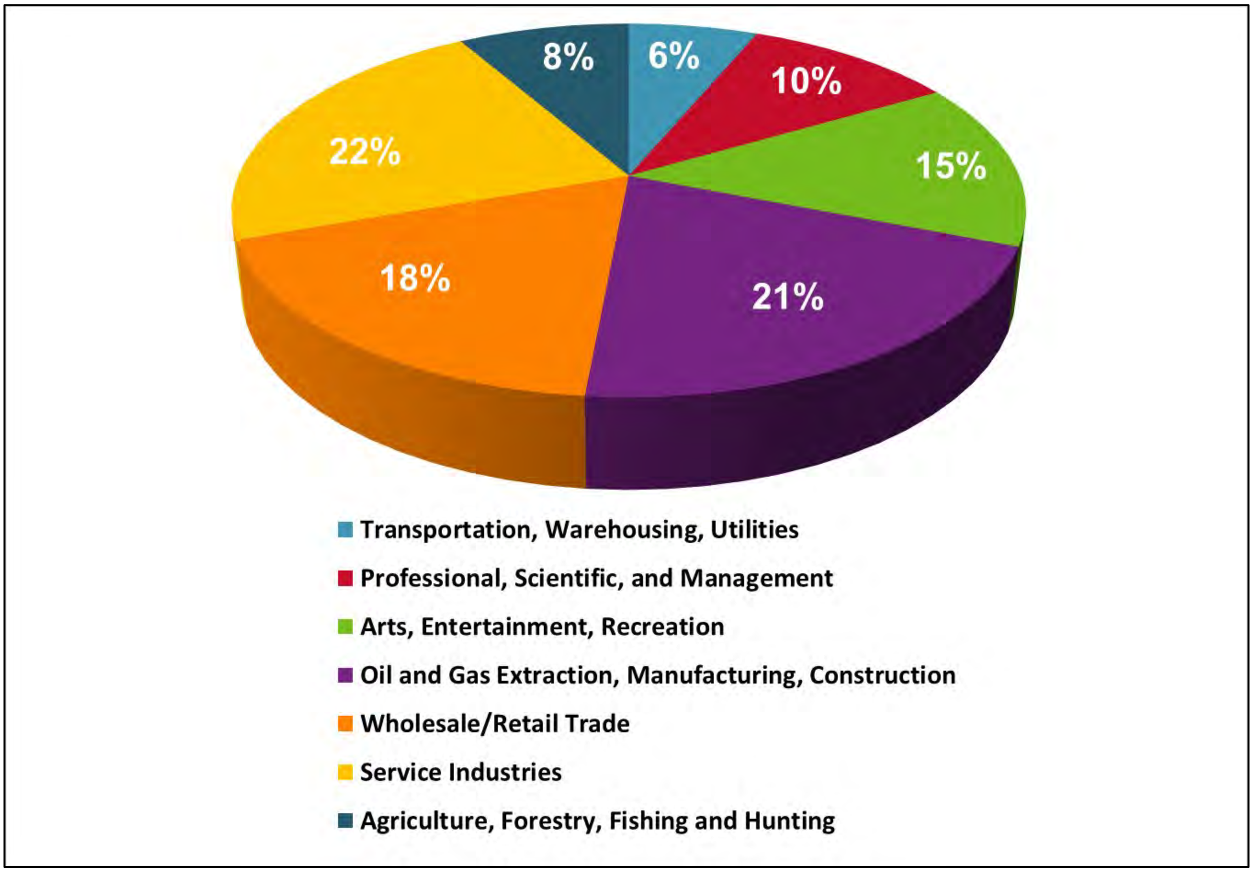


Figure 1.4.
2017 Percentages of Major Employment by Sector in the Coastal Bend Region

1.2 Current Water Use and Major Water Demand Centers

Municipal and industrial water use accounts for the greatest amount of water demand in the Coastal Bend Region, totaling 88 percent of the region's total water use of 145,528 ac-ft in 2015 (Figure 1.5). The major water demand areas are primarily municipal systems in the greater Corpus Christi area, as well as large industrial (manufacturing, steam-electric, and mining) users located along the Corpus Christi and La Quinta Ship Channels in Nueces and San Patricio Counties. Agriculture (irrigation and livestock) is the third largest category of water use in the region (Figure 1.5). Based on recent water use records, the City of Corpus Christi provides supplies for about 60 percent of the municipal and industrial water demand in the region (not including supplies to SPMWD or STWA and their customers).

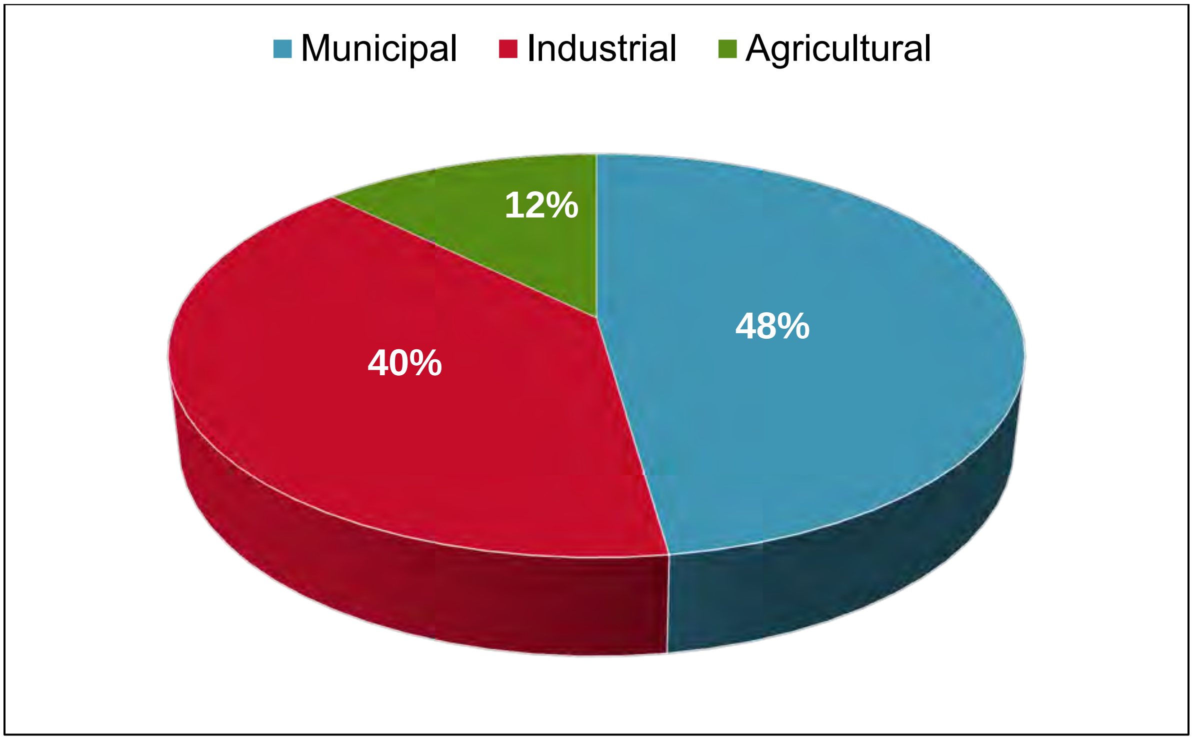


Figure 1.5.
Year 2015 Water Use in the Coastal Bend Regional Water Planning Area = 145,528 ac-ft

1.3 Current Water Supplies and Quality

The Coastal Bend Region depends mostly on surface water sources for municipal and industrial water supply use and groundwater supplies for irrigation and in rural municipal areas that are not served by the Corpus Christi Regional Water Supply System, described below. There are limited reuse supplies in Nueces and San Patricio County, representing less than 1% of the total supply for the region. Figure 1.6 shows the sources of supply for major water users in the Coastal Bend Region.

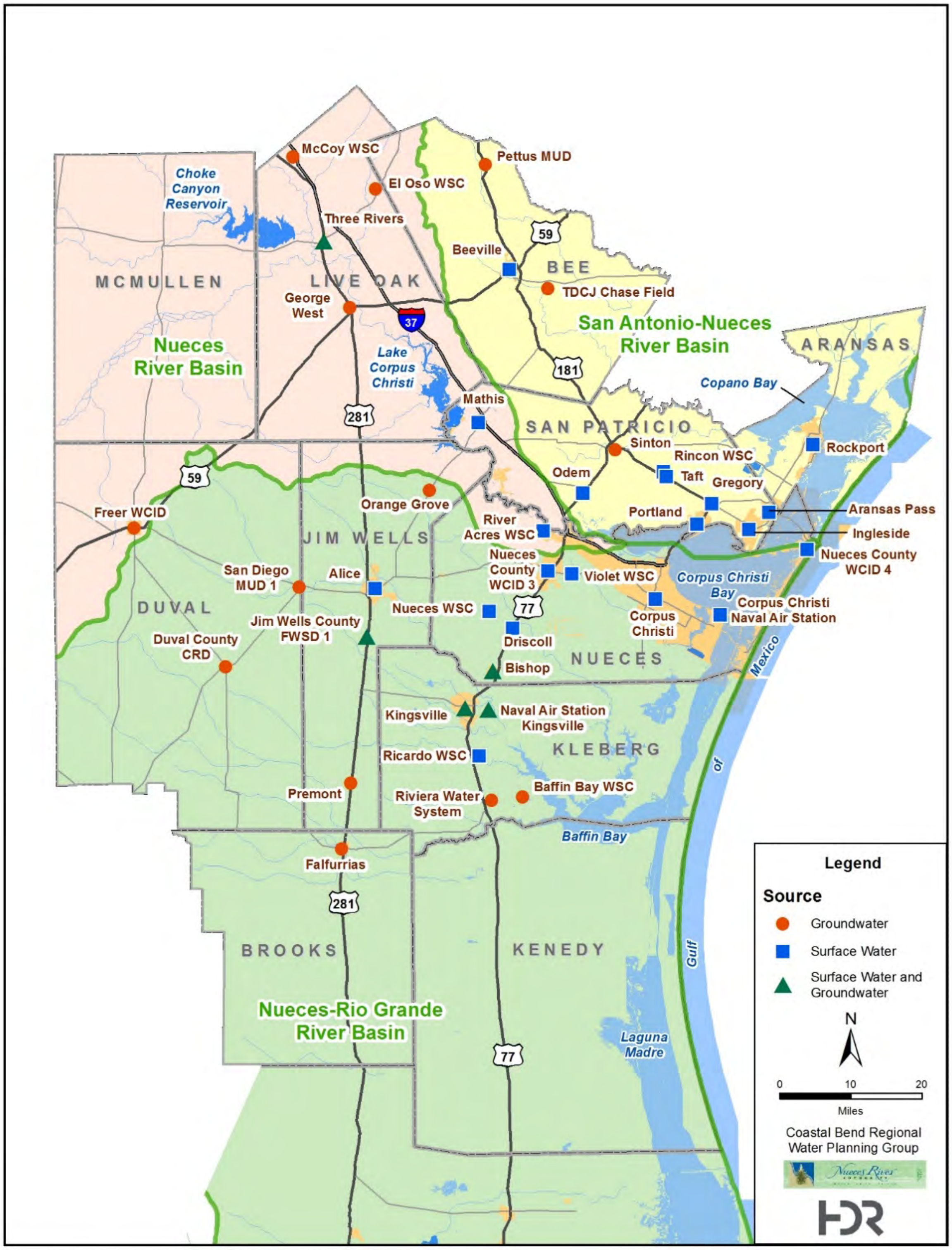


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Figure 1.6.
Current Water Sources for Providers in the Planning Region

1.3.1 Surface Water Sources

The three major surface water resources include the Choke Canyon Reservoir/Lake Corpus Christi System (CCR/LCC System) in the Nueces River Basin, Lake Texana on the Navidad River in Jackson County, and water supply from the Garwood water rights located on the Colorado River in Matagorda County. The Colorado River supplies are transported through the Mary Rhodes Phase II system to Jackson County where Lake Texana supplies are added and delivered together through the Mary Rhodes Pipeline to delivery locations in San Patricio County (San Patricio Municipal Water District) and Nueces County (City of Corpus Christi). Collectively this system is referred to as the CCR/LCC/Texana/MRP Phase II system (or Corpus Christi Regional Water Supply System). Water supply from Lake Texana provides the Coastal Bend Region with 31,440 acre-feet per year (ac-ft/yr) and 12,000 ac-ft/yr on an interruptible basis, according to the contract between the City of Corpus Christi and the Lavaca-Navidad River Authority (LNRA).[3] The City of Corpus Christi also owns the Garwood water right in the Colorado River Basin totaling 35,000 ac-ft.

In September 22, 2017, the Coastal Bend Regional Water Planning Group adopted the use of safe yield as the basis for determining availability for the Corpus Christi Regional Water Supply System. Based on 2020 sediment conditions, current Phase IV operating policy, including the 2001 Agreed Order governing freshwater pass-throughs to the Nueces Estuary, the CCR/LCC System with supplies from Lake Texana and the Colorado River through Garwood water rights (Corpus Christi Regional Water Supply System) has an annual safe yield of 178,000 ac-ft in 2020. The annual safe yield assumes 75,000 ac-ft remains in CCR/LCC system storage during the critical month of the drought of record. The Coastal Bend Regional Water Planning Group adopted the use of safe yield for supply planning, instead of the firm yield of 194,000 ac-ft/yr with zero remaining storage during historical drought of record conditions, due to historical trends showing increasing severity with each successive drought as described in Chapter 1.10.

The Nueces River Authority's 2018 Basin Summary Report[4], and the TCEQ Texas Integrated Report Index of Water Quality Impairments compiled information on 12 water quality parameters for 48 segments in the San Antonio-Nueces Coastal Basin, the Nueces River Basin, the Nueces-Rio Grande Coastal Basin, and the adjacent bays and estuaries. The report assimilated results from 303(d) List of Impaired Waters and 305(b) Water Quality Inventory and found that the water quality is generally good. However, there are some areas of concern. Choke Canyon Reservoir has nutrient concerns and resulting excessive algal growth. Lake Corpus Christi has an impairment listed for total dissolved solids (TDS) impairment. Calallen Reservoir, where water supply intakes are located, shows chlorophyll-a concerns and TDS impairment. A few stream segments within the region, as well as local bays and estuaries, had

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[3] The base permit of 41,840 ac-ft/yr is subject to call-back for up to 10,400 ac-ft/yr for Jackson County uses. Since the last round of planning, LNRA has provided notice of callback for local water users pursuant to contract terms. For this reason, current supplies include full call-back being exercised and thus reducing the base permit to 31,440 acft/yr.

[4] Nueces River Authority, "2018 Basin Summary Report for San Antonio-Nueces Coastal Basin, Nueces River Basin, and Nueces-Rio Grande Coastal Basin," August 2018.

elevated levels of dissolved solids, nutrients, bacteria, low dissolved oxygen levels, and other parameters for continued monitoring as discussed in greater detail in Chapter 1.6 (Table 1.2).

The water quality of the water from Lake Texana has been reported as good. In fact, it exceeds the general quality of the water supply from the Nueces River Basin and has less TDS than the Nueces River water. However, because Lake Texana water is blended with Nueces River water prior to treatment, the higher Total Suspended Solids (TSS) levels in the Lake Texana water and the pH difference between the two different sources requires precise controls during the treatment process. There were high levels of nitrates reported in Lake Texana around 0.37 mg/L pre-Hurricane Harvey and post-Hurricane Harvey nitrate levels were reported around 0.09 mg/L[5].

1.3.2 Groundwater Sources

Some areas in the region are dependent on groundwater. There are two major aquifers that lie beneath the region — the Carrizo-Wilcox and Gulf Coast Aquifers. The Carrizo-Wilcox Aquifer contains moderate to large amounts of either fresh or slightly saline water. Slightly saline water is defined as water that contains 1,000 to 3,000 milligrams per liter (mg/L) of dissolved solids. Although this aquifer reaches from the Rio Grande River north into Arkansas, it only underlies parts of McMullen and Live Oak Counties and a very small area of Bee County within the Coastal Bend Region. For these three counties, only McMullen County reports a Modeled Available Groundwater (MAG) value for the Carrizo Aquifer. In this downdip portion of the Carrizo-Wilcox Aquifer, the water is softer, hotter (140 degrees Fahrenheit), and contains more dissolved solids.

The Gulf Coast Aquifer underlies all counties within the Coastal Bend Region and yields moderate to large amounts of both fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five aquifer formations: Catahoula, Jasper, Burkeville, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water formations within the Gulf Coast Aquifer System and, consequently, are the formations utilized most commonly. The Evangeline portion of the Gulf Coast Aquifer features the highly transmissive Goliad Sands. The Chicot portion of the Gulf Coast Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Chicot Aquifer within the Coastal Bend area. The Burkeville Aquifer is predominantly clay, and therefore provides limited water supplies. The Texas Water Development Board (TWDB) developed a Central Gulf Coast Groundwater Availability Model (CGCGAM) and then revised the portion over Region N referred to as the Groundwater Management Area 16 (GMA 16) Groundwater Flow Model which is used to determine groundwater availability. The TWDB GMA 16 Groundwater Flow Model includes six aquifer layers: Layers 1-4 representing the Gulf Coast Aquifer (Jasper, Burkeville, Evangeline, and Chicot), Layer 5 representing the Yegua-Jackson Aquifer System, and Layer 6 aggregating Queen-City, Sparta, and Carrizo-Wilcox Aquifer System.

[5] Lavaca-Navidad River Authority, 2019 Lavaca Basin Highlights Report.

Within Texas, the Houston area is the largest user of the Gulf Coast Aquifer. Due to growing population and water demand in that area, over-pumping of the aquifer has resulted in subsidence of up to 3.71 feet being recorded in Harris County. While not as severe as in the Houston area, subsidence has been reported within the Gulf Coast Aquifer in the Coastal Bend Region. In 1979, the Texas Department of Water Resources developed a Gulf Coast Aquifer Model to evaluate pumpage, water level drawdowns, and subsidence for the 10-year period of 1960 through 1969 for Houston, Jackson-Wharton Counties, and Kingsville areas. The objective of the study was to compare modeled results to historical water level declines and subsidence.[6] Areas in Kleberg County have recorded a 0.5-foot drop in elevation due to pumping of the Gulf Coast Aquifer. However, due to the increase in surface water use within Kleberg County, water levels of the aquifer are rising and the rate of subsidence has diminished. Water quality in the shallower parts of the aquifer is generally good; however, there is saltwater intrusion occurring in the southeast portion of the aquifer along the coastline. It should also be noted that the water quality deteriorates moving southwestward towards the Texas-Mexico border.

Both Queen City and Sparta Aquifers are official minor aquifers that cover part of McMullen County. The local groundwater district has adopted small MAG values (totaling 223 ac-ft combined) for these two aquifers in McMullen County.

The Yegua-Jackson is an official minor aquifer and covers parts of McMullen, Live Oak, and Bee counties within the Coastal Bend Region. There is no Modeled Available Groundwater (MAG) recognized by the local groundwater conservation district in this aquifer in McMullen County in the Nueces basin, therefore is not used as a water supply by Region N.

1.3.3 Reuse

There is currently limited reuse occurring within the Region. According to historical data provided to the TWDB, about 1,661 ac-ft/yr of wastewater is being reused for manufacturing purposes in Nueces and San Patricio Counties. The City of Corpus Christi also provides reuse to a cemetery, has five reclaimed water customers including golf courses, parks and recreation areas. The City uses approximately 2.5% of the City's overall effluent for reclaimed water. Corpus Christi has supplied reclaimed water to its irrigation customers saving 100% of the same amount in potable water[7] . Additional reuse options are recommended to meet future water needs, as described in Chapter 5D.5.

1.3.4 Major Springs

There are no major springs in the Coastal Bend Region. Due to most areas having an underlying impervious clay layer, there has not been much opportunity for springs to form in the Coastal Bend Region. According to *Springs of Texas - Volume I* by Gunnar Brune, there are 18 small springs in the Coastal Bend Region with flow between 0.28 and 2.8 cfs and a number

[6] "Groundwater Availability in Texas," Texas Department of Water Resources, Report 238, September 1979.
[7] City of Corpus Christi, "Water Conservation Plan 2019", https://wwww.cctexas.com/sites/default/files/WAT-water-conservation-plan.pdf

of these springs produce saline, hard, alkaline water. These are the largest documented springs in the Coastal Bend Region.

1.4 Major Water Providers

The Coastal Bend Region has four current regional wholesale water providers: the City of Corpus Christi; San Patricio Municipal Water District (SPMWD); South Texas Water Authority (STWA); and Nueces County Water Control and Improvement District No.3 (Nueces County WCID 3). These four entities are considered the major water providers of the region, and no additional entities were identified as major water providers by the Coastal Bend Regional Water Planning Group during development of this plan. The City of Corpus Christi, the largest of the four, sells water to two of the other regional water providers — SPMWD and STWA. The City of Corpus Christi and the SPMWD distribute water to cities, water districts, and water supply corporations which in turn provide water to residential, commercial, and industrial customers. SPMWD also sells water directly to large industrial facilities located in San Patricio County on the La Quinta Ship Channel. STWA provides water to cities and water supply corporations that supply both residential and commercial customers within the western portion of Nueces County as well as Kleberg County. The smallest regional wholesale water provider, Nueces County WCID No. 3, provides water to the City of Robstown and River Acres WSC in Nueces County.

Two potential future wholesale water providers were identified for recommended water management strategies: the Port of Corpus Christi Authority (PCCA) and Poseidon Water. Both are associated with seawater desalination strategies to primarily serve future San Patricio County and Nueces County manufacturing users. PCCA and Poseidon Water are not considered major water providers by the Coastal Bend Regional Water Planning Group (CBRWPG).

1.5 Agricultural and Natural Resources

Agriculture accounts for a major portion of the land use within the Coastal Bend Region. Of the cultivated land in 2017, over 99 percent was dryland farmed and approximately 19,434 acres of cultivated land was irrigated (Table 1.1). The dominant crops of the region are cotton, corn, and sorghum. Livestock is a major agricultural product of the Coastal Bend Region. In 2017, livestock products made up 35.6 percent of the total market value of agriculture products.[8]

Fishing is another industry that adds to the economic value of the Coastal Bend Region. In 2017, reported bay and Gulf commercial fishing generated about $411 million in sales and value along the Texas coast.[9] Overall impact to the State's economy of commercial fishing, sport fishing and other recreational activities has been estimated by the TWDB to be $597 million per year.

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[8] 2017 Census of Agriculture. https://www.nass.usda.gov/Quick_Stats/CDQT/chapter/2/table/2/state/TX/county/311
[9] County Business Patterns, 2017. and https://www.courthousenews.com/wp-content/uploads/2018/12/noaa-report.pdf

Table 1.1.
Coastal Bend Regional Water Planning Area Agriculture Statistics – 2017

Counties	Region N Total	Aransas	Bee	Brooks	Duval	Jim Wells	Kenedy	Kleberg	Live Oak	McMullen	Nueces	San Patricio
Total Cropland (acres)	1,003,736	1,597	77,180	11,612	45,424	158,142	1,907	65,637	47,392	26,654	332,346	235,845
Irrigated Cropland (acres)	19,434	42	5,526	917	2,032	2,444	705	23	2,428	N/A	1,180	4,137
Irrigated Cropland/ Total Cropland	1.9%	2.6%	7.2%	7.9%	4.5%	1.5%	37.0%	0.0%	5.1%	N/A	0.4%	1.8%
Total Market Value of Agricultural Product ($1,000)	591,151	1,938	37,704	26,242	10,998	121,640	19,705	52,783	19,451	8,326	161,022	131,342
Market Value of Crop Products Sold ($1,000)	360,832	74	24,529	257	648	36,722	N/A	21,940	5,028	626	154,902	116,106
Market Value of Livestock Products Sold ($1,000)	210,610	1,863	13,174	25,984	10,350	84,918	N/A	30,843	14,423	7,699	6,120	15,236
Crop Products/ Total Agricultural Products	61.0%	3.8%	65.1%	1.0%	5.9%	30.2%	N/A	41.6%	25.8%	7.5%	96.2%	88.4%
Livestock Products/ Total Agricultural Products	35.6%	96.1%	34.9%	99.0%	94.1%	69.8%	N/A	58.4%	74.2%	92.5%	3.8%	11.6%

Source: 2017 Agricultural Census
N/A = Not available. Withheld in the census to avoid disclosing data for individual operations.

1.6 Identified Water Quality Concerns

The Clean Water Act of 1972 established a Federal program for restoring, maintaining, and protecting the nation's water resources. The Clean Water Act remains focused on eliminating discharge of pollutants into water resources and making rivers and streams fishable and swimmable. Water quality standards are to be met by industries, states, and communities under the Clean Water Act. Since the enactment of the Clean Water Act, more than two-thirds of the nation's waters have become fishable and swimmable, as well as a noticeable decrease of wetland and soil loss. One aspect of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES). This program regulates and monitors pollutant discharges into water resources. Whereas in the past the Environmental Protection Agency and the State of

Texas each required separate permits to discharge (one under NPDES and one under state law), recently, the State of Texas has received delegation to administer a joint “TPDES” program.

In 1998, the Clean Water Action Plan (Plan) was initiated to meet the original goals of the Clean Water Act. The main priority of this Plan is to identify watersheds and their level of possible concern. The identification of these concerns has been defined within the Texas Unified Watershed Assessment (Assessment). Each watershed was then placed into one of four defined categories — Category I: Watersheds in need of restoration; Category II: Watersheds in need of preventive action to sustain water quality; Category III: Pristine Watersheds; and Category IV: Watersheds with insufficient data. Within the Nueces River Basin some areas of concern have been placed on the Clean Water Act 303(d) medium priority list; consequently both TCEQ and the Environmental Protection Agency are targeting these areas as a Category I.

The State of Texas has initiated other water quality programs. The Texas Clean Rivers Act of 1991 created the Clean Rivers Program within TCEQ. The purpose of this program is to maintain and improve the water quality of the State of Texas’s river basins with aid from river authorities and municipalities. The Clean Rivers Program encourages public education, watershed planning, and water conservation, as well as provides technical assistance to identify pollutants and improve water quality in contaminated areas.

In the Coastal Bend Region, the Nueces River Authority (NRA) and TCEQ share the responsibility for surface water monitoring under the Clean Rivers Program. Surface water monitoring within the Coastal Bend Region focuses on freshwater stream segments within the Nueces River Basin, as well as local coastal waters. Each year, NRA and TCEQ coordinate sampling stations and divide stream segment stations between each other in order to eliminate sampling duplication. TCEQ and NRA work together to create the 305(b) Water Quality Inventory Report, which provides an overview of the status of surface waters in the Nueces River Basin and Nueces Coastal Basins. The TCEQ is responsible for administering the Total Maximum Daily Load Program, which addresses the water quality concerns of highest priority as identified in the 305(b) list. Under both the Clean Water Act and the Clean Rivers Program, surface waters must be sampled and monitored for identification of pollutants and possible areas of concern. Currently, certain water segments within the Nueces River, San Antonio- Nueces Coastal, and Nueces-Rio Grande Coastal Basins relevant to the Coastal Bend Region are posing some concerns (Table 1.2).

Table 1.2.
Water Quality Concerns

Surface Water Resource (stream segment number)	Water Quality Concerns	Water Quality Impairments
Mission River Tidal *(2001)*	None	Bacteria
Mission River Above Tidal *(2002)*	None	None
Aransas River Tidal *(2003)*	None	Bacteria
Aransas River Above Tidal *(2004)*	Nitrates, total phosphorus (P)	Bacteria
Aransas Creek *(2004A)*	None	Bacteria
Poesta Creek *(2004B)*	Low dissolved oxygen (DO)	Bacteria
Nueces River Tidal *(2101)*	Chlorophyll-a	None
Nueces River Below L. Corpus Christi *(2102)*	Chlorophyll-a	Total dissolved solids (TDS)
Lake Corpus Christi *(2103)*	None	TDS
Nueces River Above Frio River *(2104)*	Low DO, Chlorophyll-a, Nitrate, total P, Impaired Fish and Macrobenthic Community	None
Nueces River Above Holland Dam *(2105)*	Low DO, Chlorophyll-a	Low DO
Nueces River/Lower Frio River *(2106)*	Chlorophyll-a	Bacteria, TDS
Atascosa River *(2107)*	Chlorophyll-a, impaired habitat, nitrate, total phosphorus	Low DO, Bacteria, impaired fish and macrobenthic community
San Miguel Creek *(2108)*	Low dissolved oxygen	Bacteria
Choke Canyon Reservoir *(2116)*	Nutrients- excessive algal growth	None
Frio River Above Choke Canyon Reservoir *(2117)*	Low DO, nitrate, Chlorophyll-a	Bacteria, chloride, TDS
Arroyo Colorado Tidal *(2201)*	Low DO, Chlorophyll-a, nitrate	Low DO, bacteria, mercury and polychlorinated biphenyls (PCBs) in edible tissue
Arroyo Colorado Above Tidal *(2202)*	Chlorophyll-a, nitrate, total P phosphorous	Bacteria, mercury in longnose gar, PCBs in edible tissue
Petronila Creek Tidal *(2203)*	Chlorophyll-a, pH	Bacteria
Petronila Creek Above Tidal *(2204)*	Chlorophyll-a	Bacteria, chloride, sulfate, TDS
San Antonio Bay/Hynes Bay (2462)	Chlorophyll-a	Bacteria in oyster waters
Mesquite Bay (2463)	None	None
Aransas Bay (2471)	None	None
Little Bay (2471A)	Chlorophyll-a	None
Copano Bay/Port Bay (2472)	None	Bacteria in oyster waters
St. Charles Bay (2473)	Low dissolved oxygen	None
Corpus Christi Bay (2481)	None	Bacteria at recreational beaches
Nueces Bay (2482)	Chlorophyll-a	Copper, Zinc in edible tissue
Redfish Bay (2483)	None	None
Conn Brown Harbor (2483A)	Copper in water	None
Corpus Christi Inner Harbor (2484)	Ammonia, nitrate	Copper in water
Oso Bay (2485)	Chlorophyll-a, total phosphorus	Low DO, bacteria,
Oso Creek (2485A)	Chlorophyll-a, nitrates, total P	Bacteria
North Floodway (2491B)	Chlorophyll-a, Nitrate	None

Surface Water Resource (stream segment number)	Water Quality Concerns	Water Quality Impairments
Baffin Bay / Alazan Bay / Cayo del Grullo / Laguna Salada (2492)	Chlorophyll-a	None
San Fernando Creek (2492A)	Chlorophyll-a, nitrate, total P	Bacteria
South Bay (2493)	None	None
Brownsville Ship Channel (2494)	Low dissolved oxygen	Bacteria
Port Isabel Fishing Harbor (2494A)	None	Bacteria
Gulf of Mexico (2501)	None	Mercury in offshore sport fishes

Source: Nueces River Authority 2019 Basin Highlights Report: San Antonio-Nueces Coastal Basin, Nueces River Basin, Nueces-Rio Grande Coastal Basin. https://www.nueces-ra.org/CP/CRP/pdfs/2019_BHR.pdf

Note: Leona River (2109), Lower Sabinal River (2110), Upper Sabinal River (2111), Upper Nueces River (2112), Upper Frio River (2113), Hondo Creek (2114), Arroyo Colorado Tidal (2201) and Arroyo Colorado Above Tidal (2202) are reported in 2019 Basin Highlights Report but not included in table a as these segments are outside and not anticipated to impact the Coastal Bend Region.

1.7 Identified Threats to Agricultural and Natural Resources

The Coastal Bend Region's agricultural business relies on groundwater for irrigation and water for livestock. During previous planning efforts, the Coastal Bend Regional Water Planning Group identified continuing groundwater depletion as a threat to agricultural and natural resources. The Coastal Bend Region also recognizes the following additional potential threats to agricultural and natural resources:

- Shortage of freshwater and economically accessible groundwater attributable to increased irrigation demands.
- Shortage of freshwater and economically accessible groundwater attributable to development of natural gas from the shale in the Eagle Ford Group and water demands associated with hydraulic fracturing of wells.
- Deterioration of surface water quality associated with sand and gravel operations and other activities.
- Deterioration of groundwater quality and increasing concerns of possible arsenic and uranium contamination attributable to uranium mining activities.
- Potential impacts to threatened, endangered, and other species of concern.
- Potential impacts of brush control and other land management practices as currently considered in Federal studies.
- Natural disasters or other critical storms.
- Abandoned wells (oil, gas, and water).

These threats are considered for each water management strategy, and when applicable, are specifically addressed in Chapter 5D.

1.8 Summary of Existing Local and Regional Water Plans

1.8.1 2016 Coastal Bend Regional Water Plan

Senate Bill 1 was enacted by the 75th Session of the Texas Legislature in 1997. It specified that water plans be developed for regions of Texas and provided that future regulatory and financing decisions of the TCEQ and the TWDB be consistent with approved regional water plans. Furthermore, Senate Bill 1 specified that regional water planning groups submit a regional water plan by January 2001, and at least as frequently as every 5 years thereafter, for TWDB approval and inclusion in the state water plan.

In September 2016, the Coastal Bend Region submitted a plan for a 50-year planning period from 2020 to 2070 (2016 Coastal Bend Regional Water Plan), which consisted of projected population, current water supply , projected needs in the Region, and the Region's proposed water plans (water management strategies) to meet needs. The total population of the Coastal Bend Region was projected to increase from 614,790 in 2020 to 744,544 by 2070. Similarly, the total water demand was projected to increase from 261,970 ac-ft in 2020 to 343,244 ac-ft by 2070. There were 9 individual cities and water user groups (i.e. non-municipal water users, such as industrial and agricultural users) that showed projected needs during the 50-year planning horizon that increased from 10,807 ac-ft in 2020 to 50,950 in 2070. Water management strategies were identified by the CBRWPG to potentially meet water supply shortages. The TWDB evaluated social and economic impacts of not meeting projected water needs, which were included in the 2016 Coastal Bend Regional Water Plan.

1.8.2 2017 State Water Plan

In Water for Texas 2017 (State Plan), the TWDB utilized information and recommendations from the 16 individual 2016 Regional Water Plans developed by the Regional Water Planning Groups established under Senate Bill 1. In the State Plan, TWDB acknowledged that each Regional Water Planning Group identified many of the same basic recommendations to meet future water demands. These recommendations included: continue regional planning funding, support for groundwater conservation districts, brush control, water reuse, continued support of groundwater availability modeling, conservation education, ongoing funding for groundwater supply projects, and support of alternative water management strategies.

The TWDB included the projects recommended by the CBRWPG including two proposed off-channel reservoirs (GBRA Lower Basin Storage and local balancing storage reservoir to firm up run-of-the-river rights), groundwater development, seawater desalination, water treatment plant improvements, and conservation in Water for Texas 2017. Implementing all recommended strategies in the Coastal Bend Plan would result in 98,000 ac-ft of additional water supplies in 2070 at a total capital cost of $561 million. Selected major projects in the plan included:

- Seawater Desalination and Variable Salinity Project would provide 22,420 ac-ft per year at a capital cost of $248 million.

- The GBRA Lower Basin Project would yield 20,000 ac-ft per year with a capital cost of $72.5 for Region N's portion of the project (for interregional coordination with Region L).

- Local Gulf Coast Aquifer supply projects would increase groundwater supply for rural entities ranging from 43 to 1,457 ac-ft at capital costs ranging from $129,000 to $4.8 million.

- O.N. Stevens Water Treatment Plan Improvements would provide up to 28,025 ac-ft of surface water starting in 2020 at a total project cost of $44 million.

- SPMWD Industrial Water Treatment Plant Improvements would yield 18,529 ac-ft per year at a capital cost of $58.3 million.

- A Regional Brackish Groundwater Desalination Project, listed as an alternative water management strategy, would provide 24,000 ac-ft/yr at a total capital cost of $142.6 million.

1.8.3 Local Water Plans

The following is a summary of major planning efforts in the Coastal Bend Planning Region during the past several years.

In 2017, the $154 million Mary Rhodes Pipeline Phase II Project was completed to include construction of a 42-mile pipeline, two pump stations, and a sedimentation basin. The pipeline ties City of Corpus Christi Garwood water rights from the Colorado River into the City's Mary Rhodes Pipeline, which transports water from Lake Texana to the Coastal Bend Region. The water transported via the Mary Rhodes Phase II pipeline is provided to City of Corpus Christi customers including various municipal and industrial customers.

The City of Corpus Christi is continuing to study the design, construction, and operation of a seawater desalination plant for industrial and drinking water supply purposes. The objectives of this program are to evaluate feasibility and develop cost estimates, to test emerging technologies and to identify and assess site options and requirements for a full-scale facility. Desalination of seawater is feasible as a new source for some of the region's water supply needs. The study has included evaluation of desalination technology options, possible source water quality, energy requirements, environmental impacts, possible beneficial uses of by-product brine, and cost estimates for implementing a large-scale facility. In January 2020, the City submitted water rights applications for an Inner Harbor and La Quinta Channel sites that are described in greater detail in the water management strategy discussion. The next step would likely be to pilot, design, construct, and operate one or both plants when demand increases once the permits have been received (Corpus Christi, 2019). Source: https://www.cctexas.com/desal

The Corpus Christi ASR Conservation District was created in 2005. The District is located in Aransas, Kleberg, Nueces, and San Patricio Counties. There are currently no ASR facilities in operation within the District. The Corpus Christi Aquifer Storage and Recovery Feasibility Project (Project) was performed from August 2016 to May 2019 on behalf of the Corpus Christi Aquifer

Storage and Recovery Conservation District (District), with support from the Texas Water Development (TWDB) and City of Corpus Christi (City) through an inter-local agreement with the District. An exploratory test drilling program was completed to evaluate the geology and hydrogeology of the Gulf Coast aquifer system for potential ASR locations. The study also collected and analyzed hydrogeological, geochemical, and water quality data that will be used to model ASR operations and evaluate ASR feasibility. Based on the results of this Project, it is estimated that a yield of 13 MGD is attainable based on current WWTP capacity and up to 18 MGD is possible with Phase II expansion. The next phase will be a pilot well test program to confirm aquifer response, operations, prove up geochemical interactions, and identify criteria for appropriate design and operations of a full scale ASR program.

The City of Alice and the City of Beeville are currently developing water supply plans to diversify their water supplies and augment existing surface water supplies from the City of Corpus Christi during times of drought. The City of Alice received funding from the TWDB for the planning, design, and construction of a supplemental water source project, which will include two groundwater wells and a reverse osmosis treatment plant to produce treated supplies of 3,363 ac-ft/yr (~3 MGD). The City of Beeville applied to the TWDB for funding a new Chase well field project to bring on groundwater wells in a supply amount of 1,491 ac-ft/yr.

In 2018, the LNRA published its 2018 Lavaca Basin Highlights report. This report focuses primarily on water quality issues within the basin. In 2017, the Lavaca-Navidad River Basin received approximately 1.38 inches of rainfall more than total rainfall from the previous year due to Hurricane Harvey. Without this event, 2017 would have been an average rainfall year around 29.45 inches indicative of the February 2020 low reservoir level at around 70% of capacity. A rural use attainability analysis was initiated by the TCEQ and TWRI for Rocky Creek, as it was placed on the states 303d list for exceeding bacteria levels for contact recreation. A watershed protection plan was developed for Lavaca River Segment (1602_03). There are still issues with trying to control Giant Salvina; but, a biological control method seems to be effective thus far.

The Coastal Bend Bays and Estuaries Program (CBBEP) has published several studies since the 2016 Coastal Bend Regional Water Plan, which include water quality evaluations of the bay systems and impacts on key biological species of interest[10]. The CBBEP does not possess taxing, federal, state, or local authority. Rather, the CBBEP coordinates the implementation of the Bays Plan by providing limited amounts of technical and financial assistance towards meeting operating goals.

1.8.4 Groundwater Conservation District Plans

The Texas Legislature authorized in 1947 the creation of groundwater conservation districts to conserve and protect groundwater and later recognized them in 1997 as the “preferred method of determining, controlling, and managing groundwater resources.” According to the Texas Water Code, the purpose of groundwater districts is to provide for the conservation, preservation, protection, and recharge of underground water and prevent waste and control subsidence

[10] https://www.cbbep.org/publications2/

caused by pumping water.[11] There are ten counties in the 11-county Coastal Bend Region that contain groundwater conservation districts: Bee, Brooks, Duval, Jim Wells, Kleberg, Live Oak, McMullen, Nueces, Kenedy, and San Patricio (Figure 1.7). Information regarding groundwater conservation districts, including contact list, can be found on the TWDB website (http://www.twdb.texas.gov/groundwater/conservation_districts/index.asp).

Bee Groundwater Conservation District

The Bee Groundwater Conservation District was created in January 2001 and adopted Management Rules in September 2002. Their most recent Management Plan was adopted in October 2018. The Rules require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre owned or operated at a maximum annual production of 1 ac-ft per acre.

Brush Country Groundwater Conservation District

Brush Country Groundwater Conservation District was created by the 81st Texas Legislature in 2009 and includes Brooks and Jim Wells Counties within the Coastal Bend Region, as well as Jim Hogg County and a portion of Hidalgo County in Region M. The District's Rules were adopted in 2013, and amended in 2018. Their most recent Management Plan was adopted in December 2017.

Corpus Christi Aquifer Storage and Recovery Conservation District

The Corpus Christi Aquifer Storage and Recovery Conservation District was created in 2005 by the 79th Texas Legislature. The District is located in Aransas, Kleberg, Nueces, and San Patricio Counties. As with other GCDs, the major purposes of the District are to: 1) provide for conservation, preservation, protection, and recharge; 2) prevent waste; and 3) control land surface subsidence. The primary objective of the District is to facilitate the operation of aquifer storage and recovery operations by the City of Corpus Christi. The District amended its Rules in 2016. The most recent Management Plan was adopted by the District in April 2019.

Duval County Groundwater Conservation District

The Duval County GCD was created in 2005 by the 79th Texas Legislature. The District was approved by voters in 2009. The District adopted rules in February 2010. Their most recent Management Plan was adopted in December 2017.

[11] Texas Water Code б 36.0015.

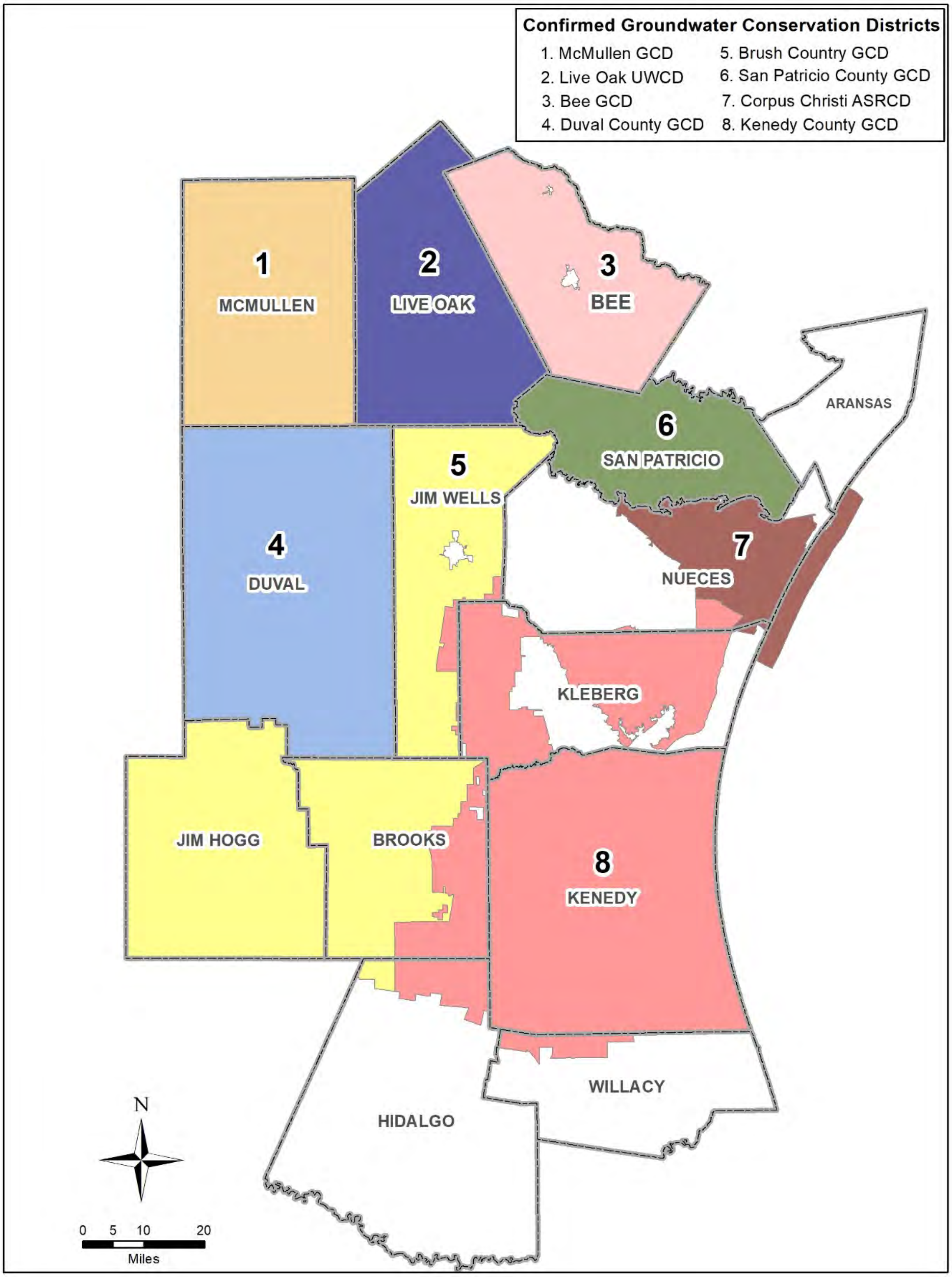

Figure 1.7.
Groundwater Conservation Districts in Region N

Live Oak Underground Water Conservation District

The Live Oak Underground Water Conservation District (LOUWCD) was created June 14, 1989 and confirmed November 7, 1989. The District adopted Management Rules in June 1998 and last amended the Rules in November 2011. The Rules require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre at a maximum annual production of 2 ac-ft per acre. The District does not allow operation of Aquifer Storage and Recovery projects. Their most recent Management Plan was adopted in March 2019.

McMullen Groundwater Conservation District

The McMullen Groundwater Conservation District was created and published District Rules in November 1999. The Rules, last amended in September 2012, require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre owned or operated at a maximum annual production of 1 ac-ft per acre. The District does not allow operation of Aquifer Storage and Recovery projects. Their most recent Management Plan was adopted in January 2019.

Kenedy County Groundwater Conservation District

The Kenedy County Groundwater Conservation District was created in 2003 and includes all of Kenedy County and parts of Brooks, Jim Wells, Kleberg, and Nueces Counties. The Rules, last amended in July 2012, require registration for all existing and future wells in the District. The District rules include spacing and production limitations on new users and limits annual production to 0.75 acre-inch/acre/year. Their most recent Management Plan was adopted in July 2017.

San Patricio County Groundwater Conservation District

The San Patricio County GCD was created by the 79th Texas Legislature in 2005. The San Patricio County GCD adopted District Rules in April 2012. Permits are required from the San Patricio County GCD prior to drilling or operating wells that can produce in excess of 25,000 gallons per day (17.4 gallons per minute). The District imposes spacing and production limitations on new users and limits annual production to 1.25 ac-ft per acre owned. Their most recent Management Plan was adopted in April 2019.

Aransas County Groundwater Conservation District

The Aransas County GCD was created by the 84th Texas Legislature in 2015. The District was dissolved in September 2019.

1.8.5 Groundwater Management Areas

Groundwater is regulated locally by groundwater conservation districts except in locations that do not have a district. Districts may issue permits that regulate pumping of groundwater and spacing of wells within their jurisdictions. Multiple districts within a single Groundwater

Management Area (GMA) determine the desired future conditions of relevant aquifers within that area.

Three GMAs are represented within the 11-county Coastal Bend Region: GMA 13, GMA 15, and GMA 16. GMA 16 has the greatest coverage extent in Region N, represented in all 11 counties in the Coastal Bend Planning Area. GMA 13 covers a portion of McMullen County. GMA 15 covers a portion of Bee County. All three of these GMAs adopted new desired future conditions (DFCs) between April 2016 and January 2017, which identify aquifer drawdown constraints for future groundwater production. These DFCs were then used by the TWDB to develop Modeled Available Groundwater estimates (MAGs) for use in development of the 2021 Region N Regional Water Plan. These MAG projections based on GMA-approved desired future conditions were discussed at the CBRWPG meeting on November 9, 2017 and confirmed to serve as the basis of groundwater availability in the 2021 Region N Plan, as described in greater detail in Chapter 3. The CBRWPG did not perform any independent analyses using groundwater availability models (GAM) to estimate groundwater availability, nor were any alternative methods utilized by the CBRWPG to estimate groundwater availabilities

Groundwater supplies in the 2021 Region N Water Plan are based on MAG projections provided by the TWDB, constrained by well capacity as reported in TCEQ PWS database. For non-municipal groundwater users with groundwater capacities that are not readily obtained from publicly available sources, the groundwater supply was calculated based on TWDB historical water use records. The final step in determining groundwater supplies was to compare the MAG-preserved well capacities to projected demands for each WUG that has historically relied on groundwater. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower.

With new rule changes since development of the 2016 Regional Water Plans, the TWDB allows the regional water planning groups to utilize a MAG peak factor for determining groundwater availability, if needed. The CBRWPG discussed MAG peak factors at its November 9, 2017 meeting and appointed a subcommittee for additional discussion. TWDB guidance and materials for determining whether or not to exercise the option of using MAG peak factors was reviewed by the Region N subcommittee on February 28, 2018 and considered when preparing their recommendation. On May 10, 2018, the CBRWPG accepted the subcommittee's recommendation not to utilize the MAG peak factor option for any counties in Region N.

For Region N, total anticipated groundwater production in any planning decade does not exceed the MAG volume in any county-aquifer location (total groundwater production includes quantities associated with both existing supplies and any recommended water management strategies). This prevents recommending water management strategies with supply volumes that would result in exceeding (i.e. "overdrafting") approved MAG volumes.

1.9 Identified Historic Drought(s) of Record within the Planning Area

In terms of severity and duration, the previous 2016 Coastal Bend (Region N) Regional Water Plan considered the drought from 1992-2002 as the drought of record. The most recent drought beginning in 2007 is discussed in the 2016 Region N Plan as potentially being a new drought of record; but, for several reasons, including that the Corpus Christi Water Supply Model hydrology period extends from 1934 to 2003, a new drought had not been confirmed at the time of plan submittal in December 2015.

In 2017, the Corpus Christi Water Supply Model was updated to include:

- Recent hydrology through 2015 to include the most recent drought of record for a total model period of 82 years (1934 to 2015), including extensions to net evaporation and ungaged runoff below LCC for recent hydrology using methods consistent with the previous model version (1934 to 2003);
- New TWDB volumetric survey data for Lake Corpus Christi (2016), Choke Canyon Reservoir (2012), and Lake Texana (2010) with updated sediment accumulation rates;
- Recent hydrology for Lake Texana and the Colorado River (for Mary Rhodes Phase II supplies) through 2015; and
- Verification that all enhancements comply with the TCEQ 2001 Agreed Order.

In 2019, additional model updates were made to include:

- Lake Texana callback of 10,400 ac-ft/yr as exercised by LNRA for local water users in Jackson County pursuant to City of Corpus Christi contract terms; and
- Operational flexibility to exercise water supply calls on the Garwood water right on the Colorado River at a variable rate according to diversion rate and priority date of the rights and based on MRP Phase II system capacities.

With the Corpus Christi Water Supply Model updated for an 82 year hydrology period through 2015 and enhanced to simulate the City's reservoir system operations with the recent MRP Phase II supply, the model was used to evaluate recent drought conditions to identify any new historic drought of record within the planning area. Average annual inflows to Lake Corpus Christi and Choke Canyon System continue to trend lower with each successive drought, with the most recent hydrology update[12] for the Corpus Christi Water Supply Model (through 2015) showing a *new* drought of record for the Corpus Christi Regional Water Supply System from 2007 to 2013. The single lowest inflow year to the Lake Corpus Christi/ Choke Canyon Reservoir system occurred in 2011. The minimum 2 year (twenty-four month) inflow to the LCC/CCR system during this most recent decade occurred from October 2010 to September 2012 at an inflow of 124,000 acft, which is 32% less than the minimum 2 year inflow to the

[12] Corpus Christi Water Supply Yield Results from Hydrology Update, June 1, 2017.

LCC/CCR system in the 1990's of 183,000 acft that occurred from August 1994 to July 1996 and was the driver of the previous drought of record.

1.10 Current Preparations for Drought within the Coastal Bend Region

At the August 10, 2017 CBRWPG meeting, the planning group considered guidance from the TWDB to use firm yield when determining surface water availability. Based on the regional water supply system being prone to severe drought and a new drought of record from 2007 to 2013, the CBRWPG's approved safe yield approach is based on maintaining a 75,000 ac-ft reserve in storage during the worst, historical drought of record. Safe yield is a standard approach that the CBRWPG and the City of Corpus Christi have consistently used in previous planning cycles as a provision for climate and growth uncertainty, such that a *specified reserve amount remains* in storage during the modeled critical drought. Based on a presentation by the City of Corpus Christi and additional information, the CBRWPG approved submittal of a hydrologic variance request to use safe yield for determining surface water supplies available to the City's Regional Water Supply System for 2021 Plan development, which was subsequently granted by the TWDB on January 5, 2018.

The supplies from the City's Regional Water Supply System that are the basis of the needs analysis of this plan are the safe yield supply which includes a provision to prepare for future droughts of greater severity than what has occurred historically (1934-2015).

Besides extensive studies of the Coastal Bend Region's water needs and future resources, much of the Region has implemented the City of Corpus Christi's Drought Contingency Plan. The City's Drought Contingency Plan is implemented when current water supplies are threatened. The Drought Contingency Plan, updated in November 2018, is initiated as the percentage of combined storage of the CCR/LCC System decreases and includes water reduction targets based on storage levels. During severe drought conditions, both municipal and wholesale customers are subject to water allocation from the City of Corpus Christi. In turn, wholesale customers are responsible to impose similar allocations on their customers. Specific drought contingency measures for the other three current wholesale water providers (SPMWD, STWA, and NCWCID #3) and other water users in the Coastal Bend Region are included in Chapter 7.

The following entities have provided a TCEQ approved drought contingency plan to the Nueces River Authority for use by the Coastal Bend RWPG:

- City of Corpus Christi
- San Patricio Municipal Water District;
- South Texas Water Authority;
- Nueces County WCID # 3;
- City of Alice;
- City of Aransas Pass;
- City of Beeville;
- El Oso WSC
- City of Falfurrias
- Holiday Beach WSC
- City of Ingleside;
- City of Kingsville;
- McCoy WSC;

- Nueces County WCID #4;
- Nueces WSC;
- City of Odem;
- City of Portland;
- Ricardo WSC
- City of Robstown
- City of Rockport;
- City of Taft;
- City of Three Rivers;
- Aransas County MUD #1
- Blueberry Hills
- El Oso WSC;
- Falfurrias
- Freer WCID
- McCoy WSC;
- LNRA
- Nueces County WCID #3;
- Nueces WSC;
- Pettus MUD
- Ricardo WSC;
- Rincon WSC;
- River Acres WSC;
- San Patricio MWD; and
- South Texas Water Authority.

Additional drought contingency information for the Coastal Bend Region is included in Chapter 7. A copy of drought contingency plans provided to the Nueces River Authority can be accessed at: https://www.nueces-ra.org/CP/RWPG/dcp.php.

1.11 TWDB Water Loss Audit Data

In accordance with 31 TAC 357.30, this 2021 Coastal Bend Regional Water Plan includes water loss information compiled by the TWDB from water loss audits provided by retail public utilities of the Coastal Bend Regional Water Planning Area pursuant to Chapter 358.6.

The 2015-2017 Water Loss Data presented in Table 1.3 was submitted to the TWDB by water utilities in Texas as required by House Bill (HB) 3338 of the 78th Texas Legislature. HB 3338 requires the TWDB to compile the information included in the water audits by type of retail public utility and by regional water planning area, and provide that information to the regional water planning groups for use in their regional water plan. The methodology used for the Water Loss Audit forms relies upon self-reporting data provided by public utilities, and due to this, the self-reported data may be unreliable and in need of further refinement.

2021 Regional Water Planning development uses utility-based planning for municipal water user groups, as delineated by water provider service areas, rather than political boundaries. The municipal water user groups include:

- _Retail public utilities_ owned by a political subdivision providing more than 100 ac-ft/yr of water for municipal use;
- _Privately-owned utilities_ that request inclusion as an individual WUG, provide more than 100 ac-ft/yr for municipal use for each owned water system, and are approved for inclusion as an individual WUG by the RWPG;
- _State or federal-owned water systems_ that request inclusion as an individual WUG, provide more than 100-AFY for municipal use, and approved for inclusion as an individual WUG by the RWPG; and

- *Collective reporting units (CRU*), or groups of retail public utilities that have a common association and are requested by the RWPG.

The TWDB provided the water loss data for 35 public utilities of the Coastal Bend Regional Water Planning Region that filed a water loss audit report for the 2015-2017 timeframe. Of the 35 public utilities that responded to the water loss survey, 11 reported having delivered less than 100 ac-ft/yr, and 24 reported having delivered more than 100 ac-ft/yr in 2015-2017.

Table 1.3 summarizes a portion of that data for each of the 35 entities. If a municipal water user group filed multiple water loss audit reports for the three years, the latest one is reported in the table. This table shows the total retail population served, total water volume input into the system, total water loss, percent loss, the value of water loss in dollars, and water loss reporting year (2015-2017).The 35 water utilities that responded to the water loss survey reported having served 533,155 people in 2015-2017 (about 87 percent of the projected 2020 regional population). Total reported water input into the systems was 137,080 ac-ft, with a reported quantity of water loss of 8,847 ac-ft. The quantity of water loss, as a percent of estimated total input water volume is calculated at about 6 percent for the region as a whole.

In addition, in accordance with 31 TAC 357.30, the regional water planning group has considered strategies to reduce water losses as further described in Chapter 5D.1.

Table 1.3.
Summary of Water Loss Survey, 2015-2017

No.	Utility Name	Retail Pop Served	System Input Volume (acft)	Water Loss (acft)	Water Loss (%)	Total Cost of Loss ($)	Water Loss Reporting Year
Utilities with Input Volumes of Less Than 100 ac-ft/yr							
1	Aransas Bay Utilities	600	85	6	7%	28,296	2015
2	Aransas County MUD1	435	43	7	16%	2,388	2016
3	City Of Ingleside On The Bay	615	60	-	0%	-	2015
4	Copano Heights Water Co	250	14	1	8%	1,998	2016
5	Copano Ridge Subdivision	675	43	4	0%	6,586	2015
6	Copano Cove Subdivision	1,235	62	8	12%	13,079	2015
7	Cyndie Park 2 WSC	45	5	0	1%	230	2016
8	Duval County CRD Concepcion	100	12	5	39%	15,100	2015
9	Duval County CRD Realitos	200	15	2	14%	69,677	2015
10	Escondido Creek Water System	120	13	0	2%	410	2015
11	Tynan WSC	250	25	2	8%	5,486	2016
Subtotal for Utilities with Less Than 100 acft/yr		**4,525**	**377**	**34**	**9%**	**143,249**	

No.	Utility Name	Retail Pop Served	System Input Volume (acft)	Water Loss (acft)	Water Loss (%)	Total Cost of Loss ($)	Water Loss Reporting Year
Utilities with Input Volumes of More Than 100 ac-ft/yr							
12	Baffin Bay WSC	1,137	110	13	12%	4,834	2015
13	City Of Bishop	3,170	131	58	44%	4,495	2015
14	City Of Orange Grove	1,587	276	29	10%	51,267	2015
15	Duval County CRD Benavides	2,225	163	26	16%	85,320	2015
16	River Acres WSC	2,500	265	14	5%	12,976	2015
17	Holiday Beach WSC	2,150	112	8	7%	10,624	2016
18	City Of Alice	19,010	3,619	562	16%	385,490	2017
19	City Of Aransas Pass	8,393	1,705	364	21%	399,278	2017
20	City Of Beeville	16,266	3,279	111	3%	420,741	2016
21	City Of Corpus Christi	325,733	106,018	6,043	6%	7,391,731	2017
22	City Of Kingsville	26,213	3,782	83	2%	15,282	2017
23	City Of Mathis	5,037	708	161	23%	52,436	2016
24	City Of Ingleside	9,656	1,043	71	7%	157,754	2016
25	City Of Portland	20,400	2,206	90	4%	95,086	2017
26	City Of Rockport	26,911	3,012	368	12%	445,864	2016
27	City Of Sinton	5,657	1,019	8	1%	2,540	2016
28	City Of Taft	3,300	446	70	16%	34,247	2017
29	City Of Three Rivers	4,413	2,298	198	9%	114,985	2016
30	Freer Wcid	2,818	510	87	17%	155,946	2015
31	Nueces County WCID 3	19,000	2,739	271	10%	620,468	2017
32	Nueces County WCID 4	10,134	2,003	34	2%	57,854	2016
33	Nueces WSC	2,670	438	40	9%	37,817	2015
34	Ricardo WSC	2,886	309	36	12%	33,892	2015
35	Rincon WSC	4,194	382	12	3%	2,872	2015
	Subtotal for Utilities with More Than 100 acft/yr	**528,630**	**136,703**	**8,812**	**6%**	**10,598,291**	
	TOTAL for all 35 entities	**533,155**	**137,080**	**8,847**	**6%**	**10,741,540**	

*Note: The water losses in this table include real and apparent losses.

1.12 Identification of Threats to Agricultural and Natural Resources, Endangered, and Rare Species of the Coastal Bend Region Affected by Water Management Strategies

While the Coastal Bend Region is known for its valuable mineral resources, especially oil and gas, this area also supports a rich diversity of living natural resources. Three distinct natural regions occur in the Coastal Bend Region; the South Texas Brush Country which characterizes the inland portion of the region, the Coastal Sand Plains along the southern coastline, and the Gulf Coast Prairies and Marshes along the northern coastline (Figure 1.8).

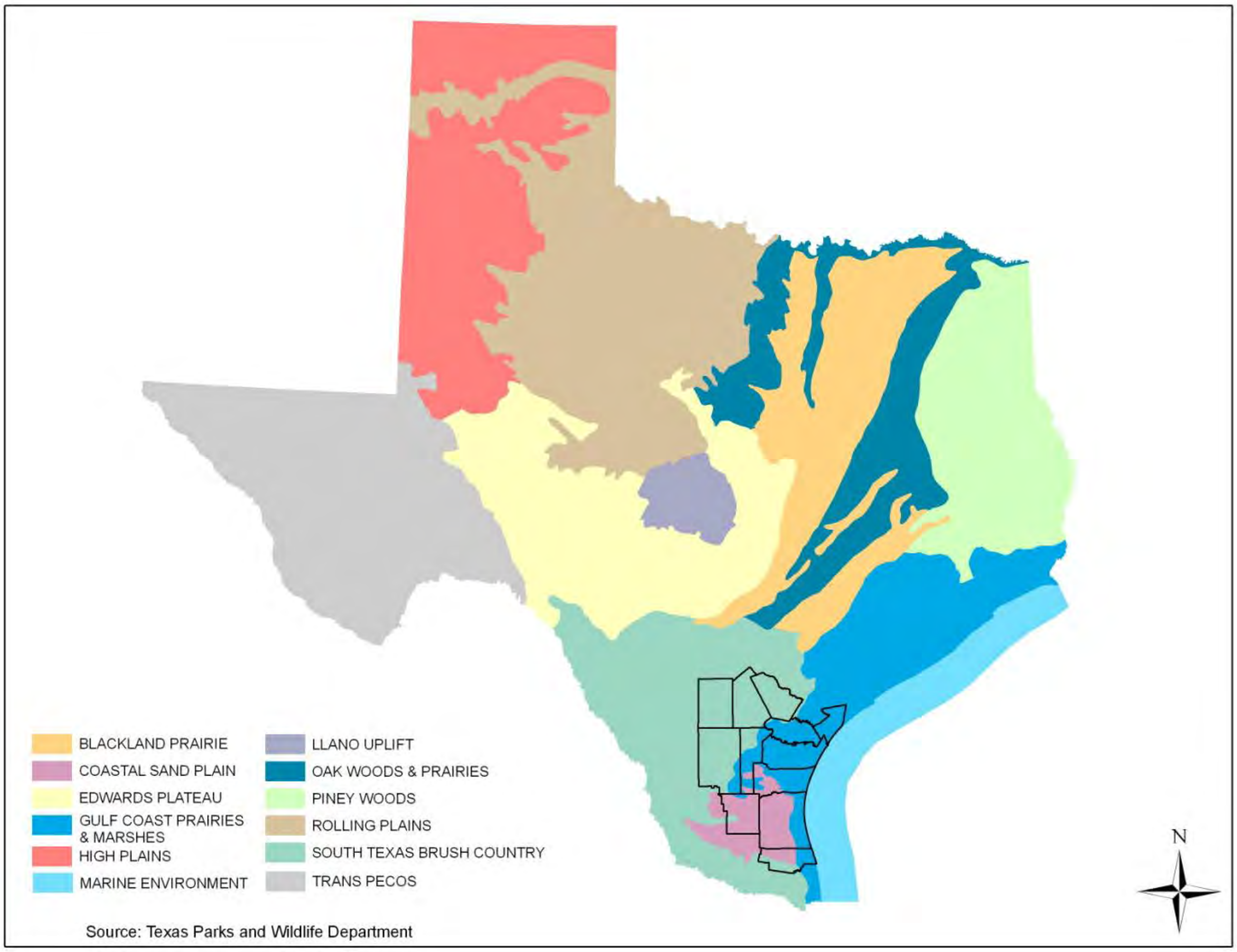

Figure 1.8.
Natural Regions of Texas

Regional water plan guidelines require identification of threats to agricultural and natural resources and discussions of how they will be addressed or affected by water management strategies evaluated in the plan. These environmental impacts include possible effects on agriculture, natural resources, wildlife habitat, cultural resources, environmental water needs, and inflows to bays and estuaries. Each water management strategy summary (Chapter 5D) includes a discussion of these environmental considerations and potential impacts associated with project implementation. The summary at the end of each Chapter 5D water management strategy summary also includes water quality concerns and impairments for stream and bay segments (Table 1.2) anticipated to be affected by or to affect the water management strategy. Water quality parameters considered in the water management strategy evaluations include: total dissolved solids, salinity, bacteria, chlorides, bromide, sulfate, uranium, arsenic, and others.

Bay and estuary systems depend on freshwater inflows for maintaining habitats and productivity. Freshwater inflows provide a mixing gradient that establishes a range of salinity, as well as nutrients that are important to the productivity of estuarine systems. In addition, freshwater inflows deposit sediments, which help maintain the deltas and barrier islands that protect the bays and marshes. Without freshwater inflows, many plant and animal species could not survive. In accordance with an order issued by the Texas Commission on Environmental Quality (TCEQ) in 1995, and the subsequent 2001 Agreed Order, Choke Canyon Reservoir and Lake Corpus Christi are operated in such a way as to "pass-through" inflows up to a certain target amount of water each month to the Nueces Bay and Estuary. This water provides the important freshwater inflows needed by the Nueces Estuary based on maximum harvest studies and inflow recommendations.

Because the Coastal Bend Region is located along many migratory flyways, birds comprise a major portion of the wildlife population found within the area. The area provides many birds with unique nesting and forage resources within its coastal prairies, wetlands, and riverine ecosystems. The brown pelican, which was delisted as a federally endangered species in 2009, utilizes the Coastal Bend's natural resources year-round while the endangered whooping crane is only found seasonally.

The Coastal Bend Region provides habitat for numerous state- and federally-listed endangered and threatened species. These listed species include birds, amphibians, reptiles, fish, mammals, and vascular plants (Table 1.4). Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service - Southwest Region Ecological Service maintain maps identifying potential habitats (by county) of each endangered or threatened species. These potential habitats are considered for each water management strategy and when possibly impacted, are noted in the appropriate water management strategy summary (Chapter 5D).

Table 1.4.
Endangered and Threatened Species of the Coastal Bend Region

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
American burying beetle	*Nicrophorus americanus*	Kleberg	Endangered	--
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Black lace cactus	*Echinocereus reichenbachii var. albertii*	Duval, Jim Wells, Kleberg, Nueces	Endangered	Endangered
Black Rail	*Laterallus jamaicensis*	Aransas, Bee, Kenedy, Kleberg, Nueces, San Patricio	Proposed Threatened	Threatened
Black-spotted newt	*Notophthalmus meridionalis*	Aransas, Bee, Brooks, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Black-striped snake	*Coniophanes imperialis*	Kenedy	—	Threatened
Blue whale	*Balaenoptera musculus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Cactus Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*	Kenedy	—	Threatened
Coues' rice rat	*Oryzomys couesi aquaticus*	Brooks, Kenedy, Kleberg	—	Threatened
Eskimo Curlew	*Numenius borealis*	San Patricio	Endangered	Endangered
Gray Hawk	*Buteo plagiatus*	Kenedy, Kleberg	--	Threatened
Green sea turtle	*Chelonia mydas*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
Gulf of Mexico Bryde's whale	*Balaenoptera edeni*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Humpback whale	*Megaptera novaeangliae*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	--
Interior Least Tern	*Sterna antillarum athalassos*	Bee, Brooks, Duval, Jim Wells, Live Oak, McMullen	Endangered	Endangered
Kemp's Ridley sea turtle	*Lepidochelys kempii*	Aransas, Kenedy, Kleberg, Nueces	Endangered	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Aransas, Kenedy, Nueces	Endangered	Endangered
Loggerhead sea turtle	*Caretta caretta*	Aransas, Kenedy, Kleberg, Nueces	Threatened	Threatened
North Atlantic right whale	*Eubalaena glacialis*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Aransas, Duval, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Northern Beardless-Tyrannulet	*Camptostoma imberbe*	Brooks, Kenedy, Kleberg	—	Threatened
Northern cat-eyed snake	*Leptodeira septentrionalis septentrionalis*	Brooks, Kenedy, Kleberg	—	Threatened
Northern scarlet snake	*Cemophora coccinea copei*	San Patricio	--	Threatened
Oceanic whitetip shark	*Carcharhinus longimanus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
Ocelot	*Leopardus pardalis*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	Endangered	Endangered
Piping Plover	*Charadrius melodus*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	Threatened	Threatened
Reddish Egret	*Egretta rufescens*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Rose-throated Becard	*Pachyramphus aglaiae*	Aransas, Kenedy	—	Threatened
Rufa Red Knot	*Calidris canutus rufa*	Aransas, Bee, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
Sei whale	*Balaenoptera borealis*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Sheep frog	*Hypopachus variolosus*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Shortfin Mako shark	*Isurus oxyrinchus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	--	Threatened
Slender rushpea	*Hoffmannseggia tenella*	Kleberg, Nueces	Endangered	Endangered
Sooty Tern	*Onychoprion fuscatus*	Kenedy, Kleberg, Nueces	—	Threatened
South Texas ambrosia	*Ambrosia cheiranthifolia*	Jim Wells, Kleberg, Nueces	Endangered	Endangered

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
South Texas siren	*Siren sp.1*	Bee. Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Speckled racer	*Drymobius margaritiferus*	Kleberg	--	Threatened
Sperm whale	*Physeter macrocephalus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Swallow-tailed Kite	*Elanoides forficatus*	Aransas, Bee, Brooks, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, San Patricio	--	Threatened
Texas Botteri's Sparrow	*Peucaea botterii texana*	Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, San Patricio	—	Threatened
Texas horned lizard	*Phrynosoma cornutum*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Texas scarlet snake	*Cemophora coccinea lineri*	Aransas, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, San Patricio	—	Threatened
Texas tortoise	*Gopherus berlandieri*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Tropical Parula	*Setophaga pitiayumi*	Aransas, Bee, Brooks, Kenedy, Kleberg, Nueces, San Patricio	—	Threatened
Walkers's manioc	*Manihot walkerae*	Duval	Endangered	Endangered
West Indian manatee	*Trichechus manatus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
White-faced Ibis	*Plegadis chihi*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
White-nosed coati	*Nasua narica*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
White-tailed hawk	*Buteo albicaudatus*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Whooping Crane	*Grus americana*	Aransas, Bee, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, San Patricio	Endangered	Endangered
Wood Stork	*Mycteria americana*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	—	Threatened
Zone-tailed Hawk	*Buteo albonotatus*	Brooks, Kenedy	—	Threatened

Source: TPWD, Annotated County List of Rare Species, Aransas, Bee, Brooks, Duval, Jim Wells, Kleberg, Kenedy, Live Oak, McMullen, Nueces, and San Patricio Counties (updated August 2020).

— Not Listed as Endangered or Threatened



2

Population and Water Demand Projections [31 TAC §357.31]

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Chapter 2: Population and Water Demand Projections

2.1 Introduction

The TWDB provided draft population, municipal and mining water demand projections to the CBRWPG in December 2016 for consideration in development of the 2021 Coastal Bend (Region N) Regional Water Plan. For the 2021 Regional Water Planning cycle, no new census data was available and county-wide population totals were the same as those in the 2016 Region N Plan/2017 State Water Plan. A key difference with this new planning cycle is that the 2017 State Water Plan population and municipal demands are transitioned from political boundaries to utility service areas for development of the 2021 Regional Water Plan. At the CBRWPG meeting on January 16, 2017, a subcommittee was appointed to review draft TWDB population, municipal water demand projections, and mining water demand projections and provide a recommendation to the CBRWPG. On April 6, 2017, the subcommittee met to review these TWDB draft projections and recommended modifications for Nueces WSC based on utility-provided information. The subcommittee recommended approving the draft TWDB mining water demand projections and all other population and municipal water demand projections provided by the TWDB. Alternate population and water demand projections were prepared for Nueces WSC[1] that were subsequently considered and adopted at the CBRWPG meeting on August 10, 2017.

On June 2, 2017 the TWDB provided draft non-municipal water demand projections (steam-electric, manufacturing, livestock, and irrigation) for CBRWPG review and comment. A Region N subcommittee comprised of six CBRWPG members was formed at the August 10, 2017 RWPG meeting to review TWDB draft steam electric, manufacturing, livestock, and irrigation water demand projections. The subcommittee met on September 7, 2017 to discuss TWDB draft projections and local data pertinent to demand projections. At the subcommittee's request, based on local feedback and data, alternative demand projections were prepared for Nueces and San Patricio County- manufacturing users and all counties with projected irrigation water demands. These alternate projections were considered and adopted by the CBRWPG at its November 9, 2017 meeting.

[1] The revision to Nueces WSC population and water demand projections was based on actual water connections and historical water use. The most recent five year average, annual growth rate for Nueces WSC is 2.75% with Aqua Utilities and Gulf Plains removed. The CBRWPG-requested changes for Nueces WSC population assumed a 2.75% annual growth rate through 2030 and then reduction to 1.37% annual growth rate from 2031 to 2070. The TWDB draft water demand projections for Year 2020 is lower than 2016 actual water use for Nueces WSC. The CBRWPG requested use of Year 2013 for base GPCD, deemed more representative of dry conditions, which was calculated after removing Aqua Utilities and Gulf Plains. The Nueces WSC water demand is based on Year 2013 GPCD and CBRWPG-approved Nueces WSC population projections.

The Nueces River Authority, administrator for Region N, submitted a letter to the TWDB requesting consideration of the CBRWPG's adopted alternate projections for Nueces WSC, Nueces County- Manufacturing, San Patricio County- Manufacturing, and irrigation users by the January 12, 2018 request submittal deadline. The TWDB approved the projections in April 2018.

This chapter contains population and water demand projections for each municipal, manufacturing, mining, irrigation, and livestock water demand projections by county and river basin for the 11-county Coastal Bend Regional Water Planning Area. These counties are located within three river basins: the Nueces River Basin, the San Antonio-Nueces Coastal Basin, and the Nueces-Rio Grande Coastal Basin (Figure 2.1).

2.2 Population Projections

From 1990 to 2010, the population in the 11-county region grew by 71,775 (from 492,829 to 564,604), an increase of 14.6 percent (0.7 percent compound annual growth), as shown in Table 2.1. This compares with a statewide increase in population of 48 percent (2.0 percent annually). The majority of the growth occurred in Nueces and San Patricio Counties, the two largest counties in the region by population. Combined, they accounted for 77 percent of the total increase, and in 2010 their populations totaled 72 percent of the region. In 2010, 60.3 percent of the region's total population lived in Nueces County, 11.5 percent in San Patricio County, 7.2 percent in Jim Wells County, 5.7 percent in Kleberg County, 5.6 percent in Bee County, and 9.7 percent in the remaining six counties combined.

The population in the 11-county region is projected to increase by 179,940 from 2010 to 2070, an increase of 31.9 percent (0.46 percent annually), as shown in Table 2.1. This compares to a statewide projected population growth in the same period of 104.8 percent (1.20 percent annually). The total population for the region in 2010 was 2.2 percent of the 25.15 million population statewide. It declines slightly by 2070, to 1.4 percent of the projected 51.49 million statewide totals. In 2070, it is projected that 61.3 percent of the region's population will live in Nueces County, 10.3 percent in San Patricio County, 6.8 percent in Kleberg County, 8.2 percent in Jim Wells County, and less than 5.0 percent in each of the remaining seven counties. Figure 2.2 shows the trend in population for the region over the planning period. 2010 is the most recent census year and is therefore referred to as the baseline for all population projections.

Kleberg, Jim Wells, Brooks, and Nueces Counties are the fastest growing counties in the region, with future projections growing at an annual rate higher than the regional average of 0.46 percent (Figure 2.3). The population growth in those counties accounts for 79 percent of the total increase over the next 60 years. The growth rate for all counties in Region N is projected to be positive over the next 60 years.

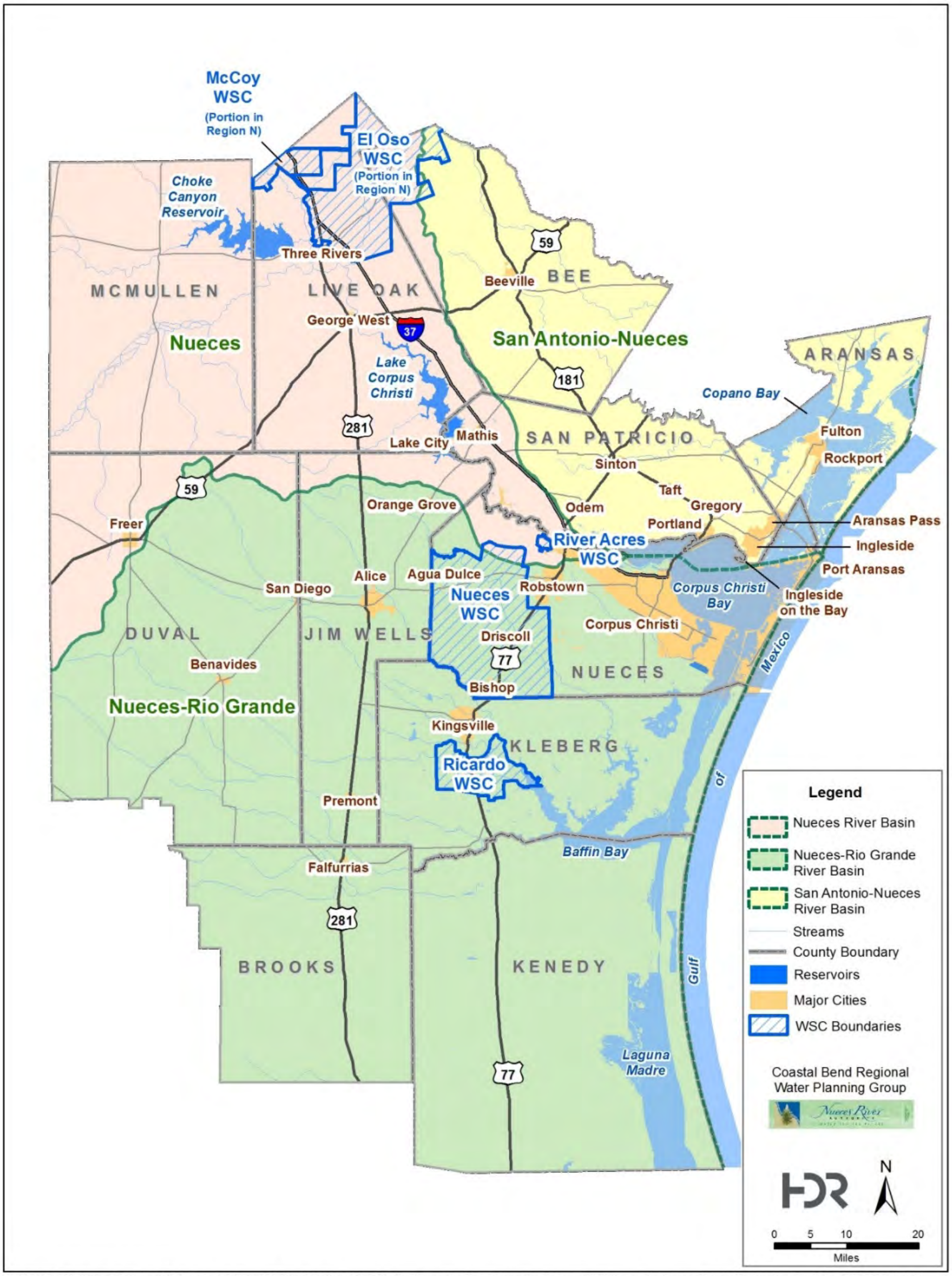


Figure 2.1.
Coastal Bend Region River Basin Boundaries

Table 2.1.
Coastal Bend Region Population (by County and River Basin)

	Historical			Projections[1]						Percent Growth[2]	Percent Growth[2]
County	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**1990-2010**	**2010-70**
Aransas	17,892	22,497	23,158	24,463	24,991	24,937	25,102	25,103	25,104	1.30%	0.13%
Bee	25,135	32,359	31,861	33,478	34,879	35,487	35,545	35,579	35,590	1.19%	0.18%
Brooks	8,204	7,976	7,223	7,783	8,252	8,722	9,181	9,595	9,979	-0.63%	0.54%
Duval	12,918	13,120	11,782	12,715	13,470	14,098	14,644	15,080	15,435	-0.46%	0.45%
Jim Wells	37,679	39,326	40,838	44,987	48,690	52,052	55,533	58,600	61,410	0.40%	0.68%
Kenedy	460	414	416	463	498	504	507	508	508	-0.50%	0.33%
Kleberg	30,274	31,549	32,061	35,567	38,963	42,202	45,324	48,251	50,989	0.29%	0.78%
Live Oak	9,556	12,309	11,531	11,683	11,690	11,690	11,690	11,690	11,690	0.94%	0.02%
McMullen	817	851	707	734	734	734	734	734	734	-0.72%	0.06%
Nueces	291,145	313,645	340,223	374,157	407,534	428,513	440,797	449,936	456,056	0.78%	0.49%
San Patricio	58,749	67,138	64,804	68,760	72,114	74,043	75,451	76,405	77,049	0.49%	0.29%
Total for Region	**492,829**	**541,184**	**564,604**	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**	**0.68%**	**0.46%**
River Basin											
Nueces	40,062	56,482	56,460	60,225	63,779	66,072	67,589	68,724	69,544	1.73%	0.35%
Nueces-Rio Grande	360,810	372,608	400,869	437,414	476,063	502,716	521,285	536,258	547,931	0.53%	0.52%
San Antonio-Nueces	91,957	112,094	107,275	117,151	121,973	124,194	125,634	126,499	127,069	0.77%	0.28%
Total for Region	**492,829**	**541,184**	**564,604**	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**	**0.68%**	**0.46%**
Total for Texas	**16,986,510**	**20,851,790**	**25,145,561**	**29,695,345**	**33,913,233**	**38,063,056**	**42,294,281**	**46,763,473**	**51,486,113**	**1.98%**	**1.20%**

[1] Projections from Texas Water Development Board.
[2] Compound annual growth rate.

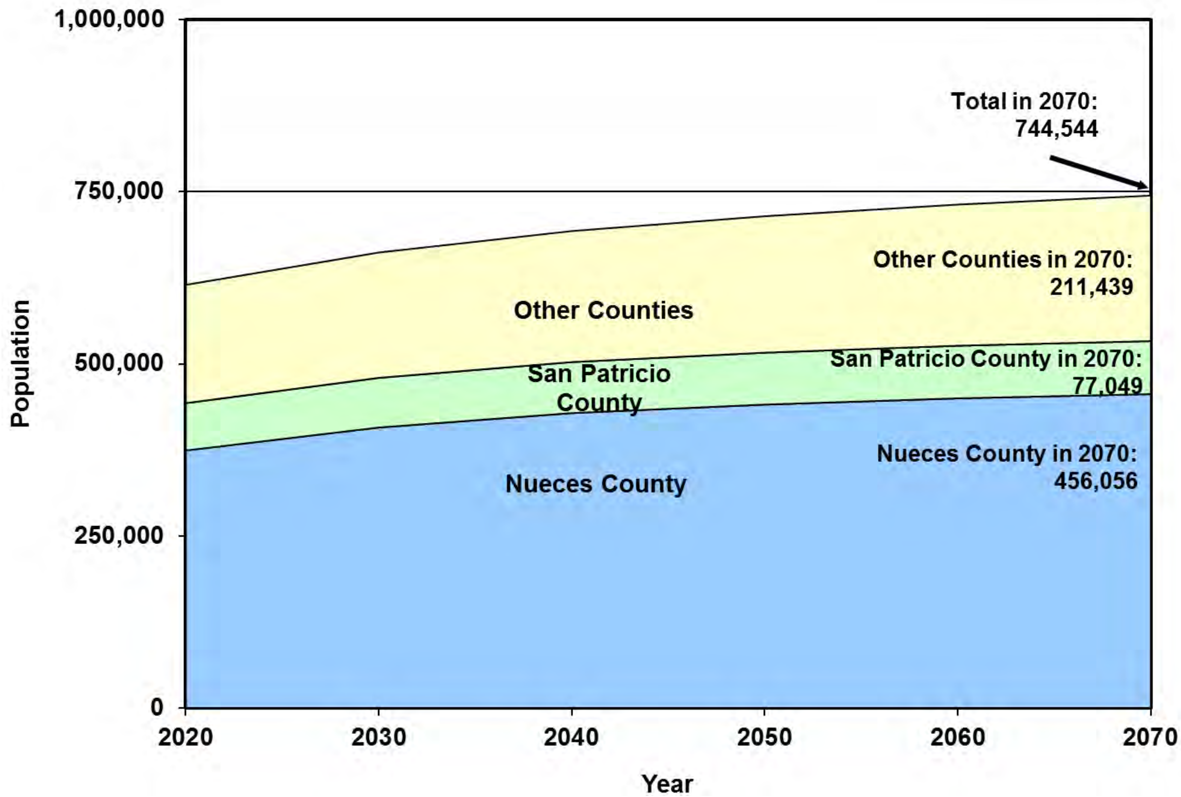


Figure 2.2.
Coastal Bend Region Population

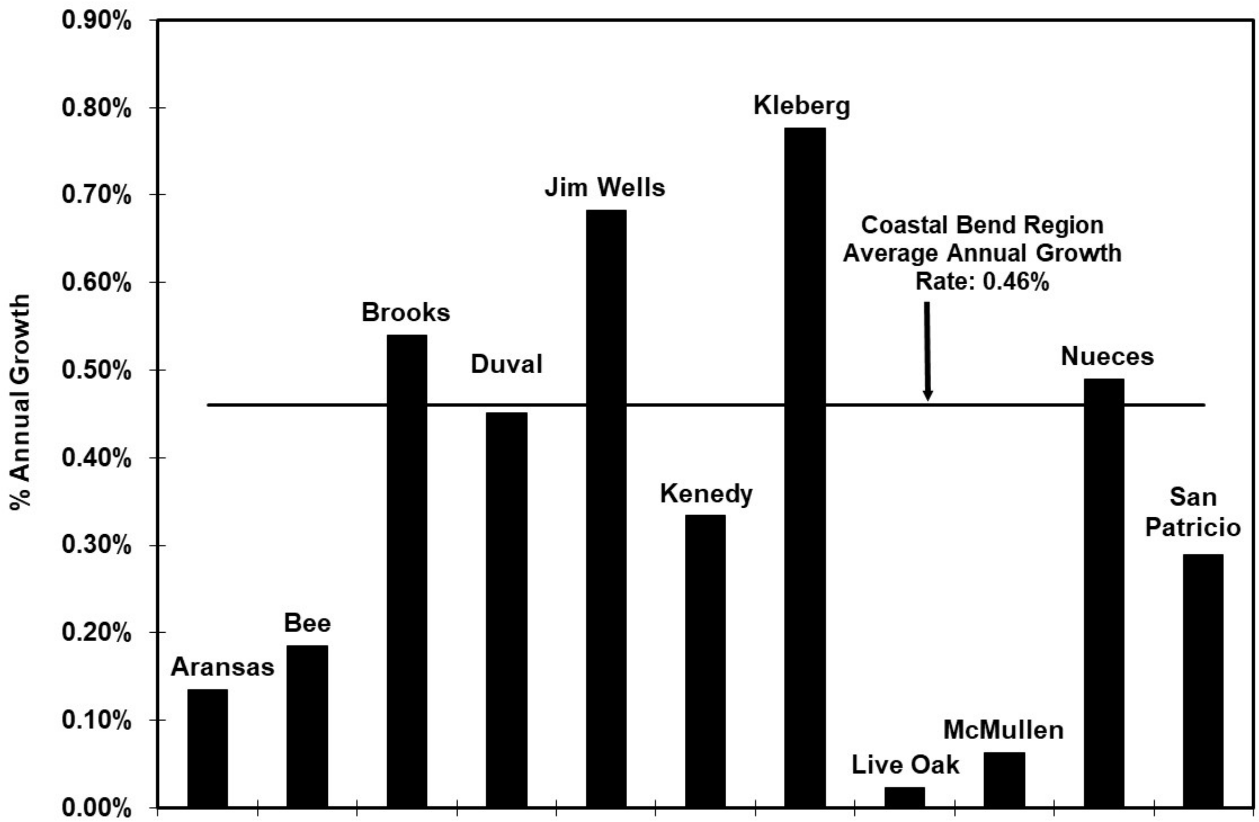


Figure 2.3.
Percent Annual Population Growth Rate for 2010 through 2070 by County

Corpus Christi and Kingsville are the two largest cities in the region, accounting for 58.7 percent of the total population in 2010, increasing to 59.9 percent of the total in 2070. Population projections for the 46 cities, water supply corporations, and ‘county-other’ users in the region are shown in Table 2.2. County-Other category includes persons residing outside of cities and also outside water utility boundaries. Population for water user groups by county and river basin are included in the Appendix.

Table 2.2.
Coastal Bend Region Population (by City/County)

City/County	1990	2000	2010	2020	2030	2040	2050	2060	2070	Percent Growth[2] 1990-10	Percent Growth[2] 2010-70
	Historical			*Projections [1]*							
ARANSAS PASS (P)	912	867	724	927	948	946	952	952	952	-1.15%	0.46%
ROCKPORT	5,355	7,385	8,766	19,120	19,533	19,491	19,620	19,622	19,622	2.49%	1.35%
COUNTY-OTHER	10,862	12,692	13,668	4,416	4,510	4,500	4,530	4,529	4,530	0.011556	-0.018237
Aransas County	*17,892*	*22,497*	*23,158*	*24,463*	*24,991*	*24,937*	*25,102*	*25,103*	*25,104*	*1.30%*	*0.13%*
BEEVILLE	13,547	13,129	12,863	15,418	16,063	16,343	16,369	16,385	16,391	-0.26%	0.40%
EL OSO WSC (P)	271	320	367	463	483	491	493	493	493	1.53%	0.49%
COUNTY-OTHER	11,317	18,910	18,631	13,472	14,036	14,280	14,303	14,317	14,321	2.52%	-0.44%
PETTUS MUD	--	--	--	700	729	742	743	744	744	N/A	N/A
TDCJ CHASE FIELD	--	--	--	3,425	3,568	3,631	3,637	3,640	3,641	N/A	N/A
Bee County	*25,135*	*32,359*	*31,861*	*33,478*	*34,879*	*35,487*	*35,545*	*35,579*	*35,590*	*1.19%*	*0.18%*
FALFURRIAS	5,788	5,297	4,981	6,018	6,238	6,452	6,646	6,826	7,064	-0.75%	0.58%
COUNTY-OTHER	2,416	2,679	2,242	1,765	2,014	2,270	2,535	2,769	2,915	-0.37%	0.44%
Brooks County	*8,204*	*7,976*	*7,223*	*7,783*	*8,252*	*8,722*	*9,181*	*9,595*	*9,979*	*-0.63%*	*0.54%*
FREER	3,271	3,241	2,818	3,041	3,221	3,370	3,502	3,605	3,691	-0.74%	0.45%
SAN DIEGO (P)	4,109	3,928	3,588	4,044	4,304	4,524	4,725	4,892	5,034	-0.68%	0.57%
COUNTY-OTHER	5,538	5,951	5,376	3,771	3,974	4,142	4,275	4,377	4,452	-0.15%	-0.31%
DUVAL COUNTY CRD	--	--	--	1,859	1,971	2,062	2,142	2,206	2,258	N/A	N/A
Duval County	*12,918*	*13,120*	*11,782*	*12,715*	*13,470*	*14,098*	*14,644*	*15,080*	*15,435*	*-0.46%*	*0.45%*
ALICE	19,788	19,010	19,104	22,566	24,424	26,110	27,856	29,395	30,804	-0.18%	0.80%
ORANGE GROVE	1,175	1,288	1,318	1,838	1,990	2,127	2,270	2,396	2,510	0.58%	1.08%
PREMONT	2,914	2,772	2,653	2,923	3,164	3,382	3,608	3,807	3,990	-0.47%	0.68%
SAN DIEGO MUD 1	874	825	900	942	1,002	1,054	1,101	1,140	1,173	0.15%	0.44%
COUNTY-OTHER	12,928	15,431	16,863	14,775	16,008	17,131	18,300	19,331	20,280	1.34%	0.31%
JIM WELLS COUNTY FWSD 1	--	--	--	1,943	2,102	2,248	2,398	2,531	2,653	N/A	N/A
Jim Wells County	*37,679*	*39,326*	*40,838*	*44,987*	*48,690*	*52,052*	*55,533*	*58,600*	*61,410*	*0.40%*	*0.68%*
COUNTY-OTHER	460	414	416	463	498	504	507	508	508	-0.50%	0.33%
Kenedy County	*460*	*414*	*416*	*463*	*498*	*504*	*507*	*508*	*508*	*-0.50%*	*0.33%*
KINGSVILLE	25,276	25,575	26,213	28,892	31,651	34,282	36,817	39,194	41,419	0.18%	0.77%
RICARDO WSC	1,503	2,301	2,631	2,919	3,198	3,464	3,720	3,960	4,185	2.84%	0.78%
BAFFIN BAY WSC	--	--	--	1,440	1,579	1,709	1,834	1,953	2,064	N/A	N/A
NAVAL AIR STATION KINGSVILLE	--	--	--	53	59	63	68	72	76	N/A	N/A
COUNTY-OTHER	3,495	3,673	3,217	1,527	1,669	1,810	1,947	2,073	2,189	-0.41%	-0.64%
RIVIERA WATER SYSTEM	--	--	--	736	807	874	938	999	1,056	N/A	N/A
Kleberg County	*30,274*	*31,549*	*32,061*	*35,567*	*38,963*	*42,202*	*45,324*	*48,251*	*50,989*	*0.29%*	*0.78%*

Table 2.2. (Continued)

City/County	---- Historical ---- 1990	2000	2010	---- Projections [1] ---- 2020	2030	2040	2050	2060	2070	Percent Growth[2] 1990-10	Percent Growth[2] 2010-70
EL OSO (P)	*812*	*1,000*	652	827	827	827	827	827	827	-1.09%	0.40%
GEORGE WEST	2,586	2,524	2,445	2,374	2,375	2,375	2,375	2,375	2,375	-0.28%	-0.05%
MCCOY WSC (P)	185	443	169	170	170	170	170	170	170	-0.45%	0.01%
THREE RIVERS	1,889	1,878	1,848	3,146	3,148	3,148	3,148	3,148	3,148	-0.11%	0.89%
COUNTY-OTHER	4,084	6,464	6,417	5,166	5,170	5,170	5,170	5,170	5,170	2.29%	-0.36%
Live Oak County	*9,556*	*12,309*	*11,531*	*11,683*	*11,690*	*11,690*	*11,690*	*11,690*	*11,690*	*0.94%*	*0.02%*
COUNTY-OTHER	817	851	707	734	734	734	734	734	734	-0.72%	0.06%
McMullen County	*817*	*851*	*707*	*734*	*734*	*734*	*734*	*734*	*734*	*-0.72%*	*0.06%*
ARANSAS PASS (P)	22	70	14	11	12	13	13	13	13	-2.23%	-0.12%
BISHOP	3,337	3,305	3,134	3,446	3,754	3,947	4,060	4,144	4,201	-0.31%	0.49%
CORPUS CHRISTI	257,453	277,450	305,215	332,002	361,618	380,234	391,134	399,244	404,674	0.85%	0.47%
CORPUS CHRISTI NAVAL AIR STATION	--	--	--	707	770	810	833	850	862	N/A	N/A
DRISCOLL	688	825	739	812	885	930	957	977	990	0.36%	0.49%
NUECES WSC	--	--	2,322	2,713	3,559	4,079	4,676	5,360	6,144	N/A	1.63%
RIVER ACRES WSC	2,130	2,750	2,421	2,662	2,899	3,049	3,137	3,201	3,245	0.64%	0.49%
COUNTY-OTHER	27,515	29,245	26,378	11,222	12,671	13,693	14,000	13,988	13,656	-0.21%	-1.09%
NUECES COUNTY WCID 3	--	--	--	13,594	13,756	13,756	13,756	13,756	13,756	N/A	N/A
NUECES COUNTY WCID 4	--	--	--	4,846	5,277	5,549	5,708	5,827	5,905	N/A	N/A
VIOLET WSC	--	--	--	2,142	2,333	2,453	2,523	2,576	2,610	N/A	N/A
Nueces County	*291,145*	*313,645*	*340,223*	*374,157*	*407,534*	*428,513*	*440,797*	*449,936*	*456,056*	*0.78%*	*0.49%*
ARANSAS PASS (P)	6,246	7,201	7,466	9,603	10,073	10,342	10,538	10,672	10,761	0.90%	0.61%
GREGORY	2,458	2,318	1,907	2,024	2,123	2,179	2,221	2,249	2,268	-1.26%	0.29%
INGLESIDE	5,696	9,388	9,387	9,610	10,078	10,348	10,545	10,678	10,768	2.53%	0.23%
MATHIS	5,423	5,034	4,942	5,114	5,364	5,507	5,611	5,683	5,730	-0.46%	0.25%
ODEM	2,366	2,499	2,389	2,647	2,777	2,852	2,905	2,942	2,967	0.05%	0.36%
PORTLAND	12,224	14,827	15,099	20,646	21,654	22,233	22,655	22,941	23,136	1.06%	0.71%
RINCON WSC	--	--	3,243	3,660	3,839	3,942	4,016	4,068	4,101	N/A	0.39%
SINTON	5,549	5,676	5,665	5,738	6,019	6,179	6,296	6,377	6,430	0.10%	0.21%
TAFT	3,222	3,396	3,048	3,768	3,951	4,057	4,133	4,186	4,221	-0.28%	0.54%
COUNTY-OTHER	15,565	16,799	11,658	5,950	6,236	6,404	6,531	6,609	6,667	-1.43%	-0.93%
San Patricio County	*58,749*	*67,138*	*64,804*	*68,760*	*72,114*	*74,043*	*75,451*	*76,405*	*77,049*	*0.49%*	*0.29%*
Total For Region	**492,829**	**541,184**	**564,604**	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**	**0.68%**	**0.46%**

Notes:
[1] Projections from Texas Water Development Board (P) Partial
[2] Compound annual growth rate

2.3 Water Demand Projections

The TWDB water demand projections have been compiled for each type of consumptive water use: municipal, manufacturing, steam-electric power, mining, irrigation, and livestock. In these consumptive types of water use there is a "loss" in water. In non-consumptive water use, such as navigation, hydroelectric generating, or recreation, there is little or no water loss. As shown in Table 2.3, total water use for the region is projected to increase by 88,704 ac-ft/yr between 2010 and 2070, from 187,788 ac-ft/yr to 276,492 ac-ft/yr, a 47.2 percent rise. Municipal, manufacturing, steam-electric, irrigation, and mining water use are all projected to increase, while livestock use is projected to remain at 6,065 ac-ft/yr from 2020 to 2070. The trend in projected total water use for the region is shown in Figure 2.4. In 2010, 59.6 percent of the total water use was for municipal purposes, 23.9 percent for manufacturing, 0.2 percent for steam-electric water, 2.8 percent for mining, 9.8 percent for irrigation, and 3.8 percent for livestock. In 2070, municipal use as a percentage of the total is projected to decrease to 47.8 percent, manufacturing use to increase to 35.6 percent, steam-electric water use to increase to 1.4 percent, mining use to decrease to 2.0 percent, irrigation water use to increase to 10.9 percent, and livestock use to decrease to 2.2 percent. Municipal water demand projections include water conservation attributed to updated plumbing code savings. These components of total water use for 2010 and 2070 are shown in Figure 2.5.

Table 2.3.
Coastal Bend Region Total Water Demand by Type of Use and River Basin (ac-ft/yr)

	Historical		Projections[1]					
Water Use	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	98,573	111,854	115,366	121,198	124,655	127,324	130,021	132,248
Manufacturing	54,481	44,820	88,634	98,480	98,480	98,480	98,480	98,480
Steam-Electric	8,799	388[2]	3,996	3,996	3,996	3,996	3,996	3,996
Mining	12,397	5,255	8,951	9,821	9,660	7,206	6,157	5,497
Irrigation	21,971	18,398	30,206	30,206	30,206	30,206	30,206	30,206
Livestock	8,838	7,073	6,065	6,065	6,065	6,065	6,065	6,065
Total for Region	**205,059**	**187,788**	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**
River Basin	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Nueces	38,217	41,313	51,441	55,626	55,840	53,739	52,981	52,526
Nueces-Rio Grande	136,744	107,039	146,734	157,153	160,285	162,608	164,933	166,857
San Antonio-Nueces	30,098	39,435	55,043	56,987	56,937	56,930	57,011	57,109
Total for Region	**205,059**	**187,788**	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**

[1] Projections from Texas Water Development Board

[2] Decline in water use likely attributable to reporting refinement to should consumptive use only, rather than total cooling use that includes return flows.

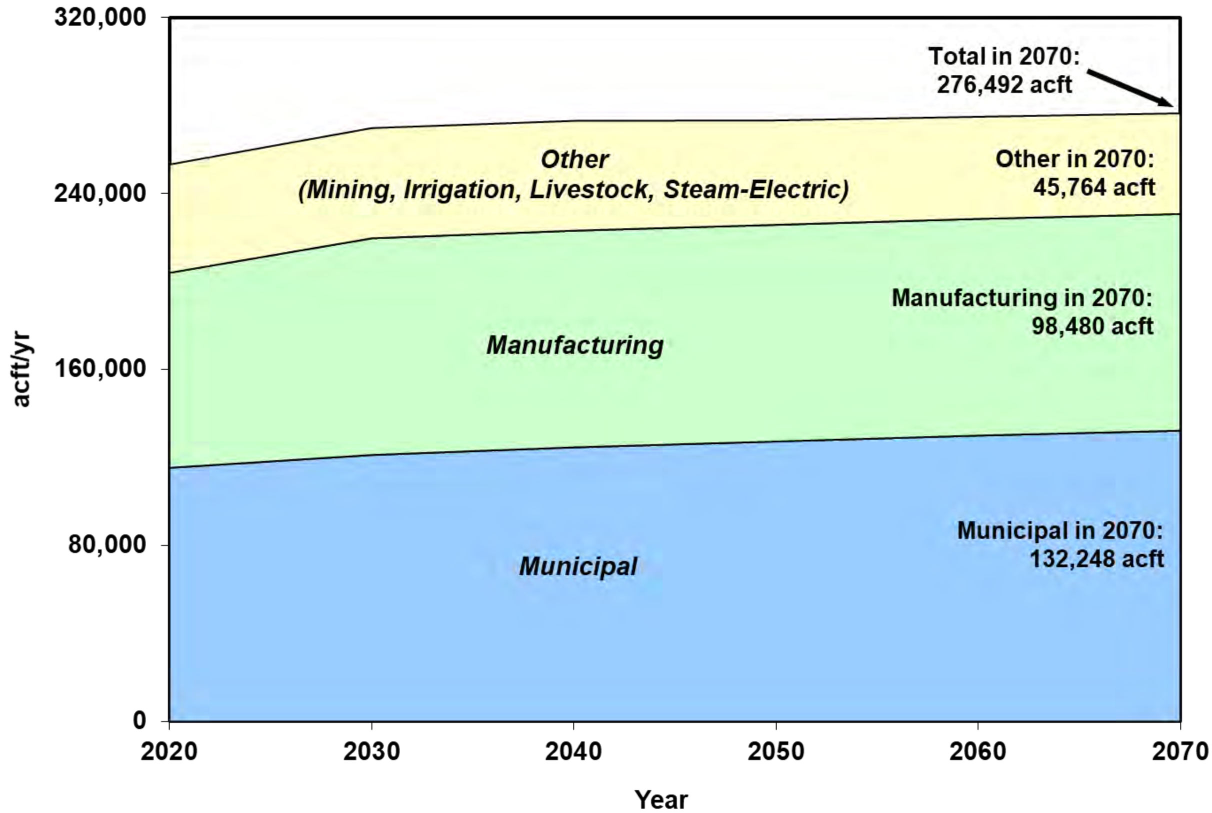


Figure 2.4.
Coastal Bend Region Water Demand

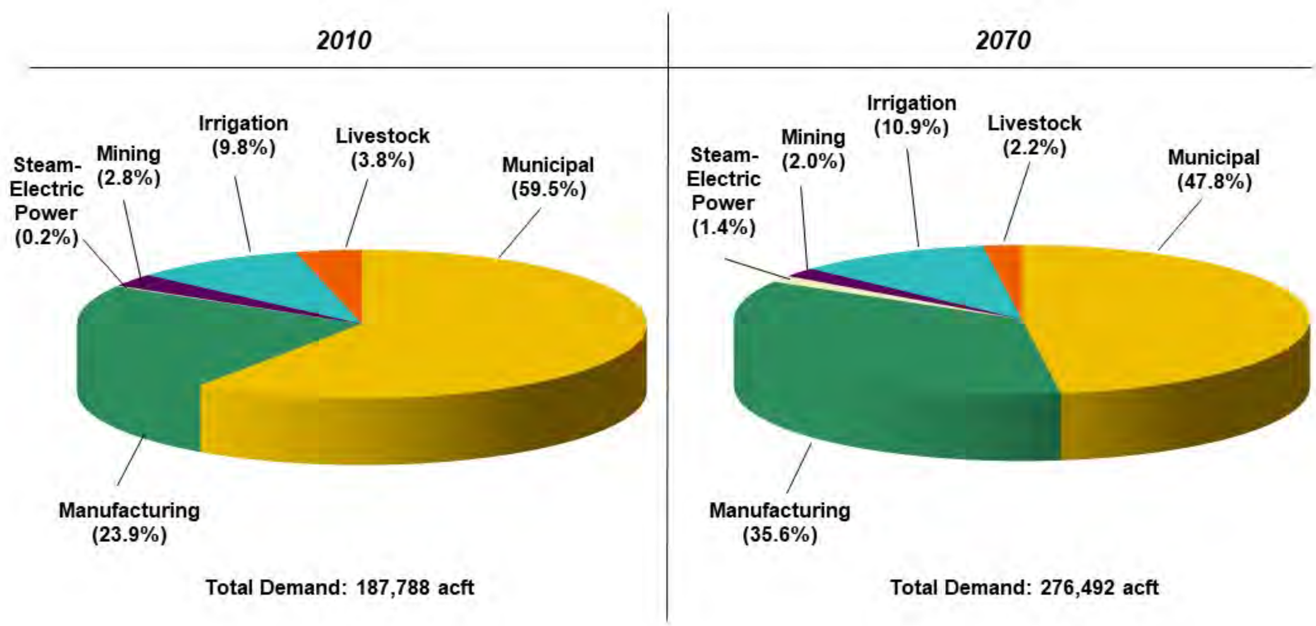


Figure 2.5.
Total Water Demand by Type of Use

2.3.1 Municipal Water Demand

Water that is used by households (e.g., drinking, bathing, food preparation, dishwashing, laundry, flushing toilets, lawn watering and landscaping, swimming pools and hot tubs) commercial establishments (e.g., restaurants, car washes, hotels, laundromats, and office buildings) and for fire protection, public recreation and sanitation are all referred to as municipal water. This type of water must meet safe drinking water standards as specified by Federal and State laws and regulations.

The TWDB computes the municipal water demand projections by multiplying the projected population of an entity by the entity's projected per capita water use, adjusted for conservation savings. Again, projected population is the "most-likely" scenario. The projected per capita water use takes into account current plumbing fixtures as well as water savings due to plumbing fixture requirements identified in the Texas Health and Safety Code, Chapter 372. Any additional changes in plumbing fixtures to promote more aggressive water savings beyond those realized in the Texas Health and Safety Code, would be expected to reduce projected water demands. The projected per capita water use is an "expected" scenario of water conservation including installation of water-efficient plumbing fixtures as defined by the 1991 State Water-Efficient Plumbing Act. In all cases, applying this conservation scenario to the per capita use results in a declining per capita water use over time.

In 2010, total reported municipal use in the Coastal Bend Region was 111,854 ac-ft/yr[2]. Nueces and San Patricio Counties accounted for 76.8 percent of the total. Municipal use is projected to increase 18.2 percent to 132,248 ac-ft by year 2070 (Table 2.4). Kenedy, Kleberg, and Jim Wells Counties will experience the largest increases, 141.3 percent, 79.5 percent, and 68.5 percent, respectively. By 2070, Nueces and San Patricio Counties will account for 73.6 percent of the total municipal water use in the region (Figure 2.6).

Generally, the increase in water use for the entities in the region is less than their respective increases in population (i.e., low flow plumbing fixtures). This is attributable to a declining per capita water use, which includes conservation built-in the TWDB demand projections. Per capita water use in Corpus Christi is projected to decline 10 percent, from 182 gallons per capita daily (gpcd) in 2011 to 164 gpcd in 2070. The average per capita water use of all municipal water user groups in the Coastal Bend Region was 171 gpcd in 2011, which is projected to decline to 159 gpcd in 2070 with conservation built-in the TWDB demand projections. Additional water conservation recommended by the Coastal Bend Regional Water Planning Group for select municipal water user group entities is described in 5D.1. Municipal water use projections for the 50 entities in the region, including County- Other, are presented in Table 2.5.

[2] TWDB Water Use Survey, 2010.

Table 2.4.
Coastal Bend Region Municipal Water Demand by County (ac-ft/yr)

County	Historical		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	3,314	3,986	4,085	4,080	3,999	3,987	3,979	3,979
Bee	4,220	6,062	6,439	6,553	6,547	6,506	6,496	6,497
Brooks	1,970	1,842	1,863	1,914	1,972	2,042	2,114	2,193
Duval	2,323	1,947	2,171	2,236	2,291	2,353	2,420	2,477
Jim Wells	8,562	6,193	8,079	8,524	8,943	9,459	9,960	10,434
Kenedy	46	109	244	260	262	263	263	263
Kleberg	5,415	4,033	5,409	5,744	6,078	6,457	6,857	7,241
Live Oak	1,990	1,649	1,816	1,770	1,733	1,716	1,703	1,703
McMullen	135	156	97	94	91	89	89	89
Nueces	61,725	77,024	74,908	79,586	82,244	83,865	85,444	86,589
San Patricio	8,873	8,853	10,255	10,437	10,495	10,587	10,696	10,783
Total for Region	**98,573**	**111,854**	**115,366**	**121,198**	**124,655**	**127,324**	**130,021**	**132,248**

[1] Projections from Texas Water Development Board

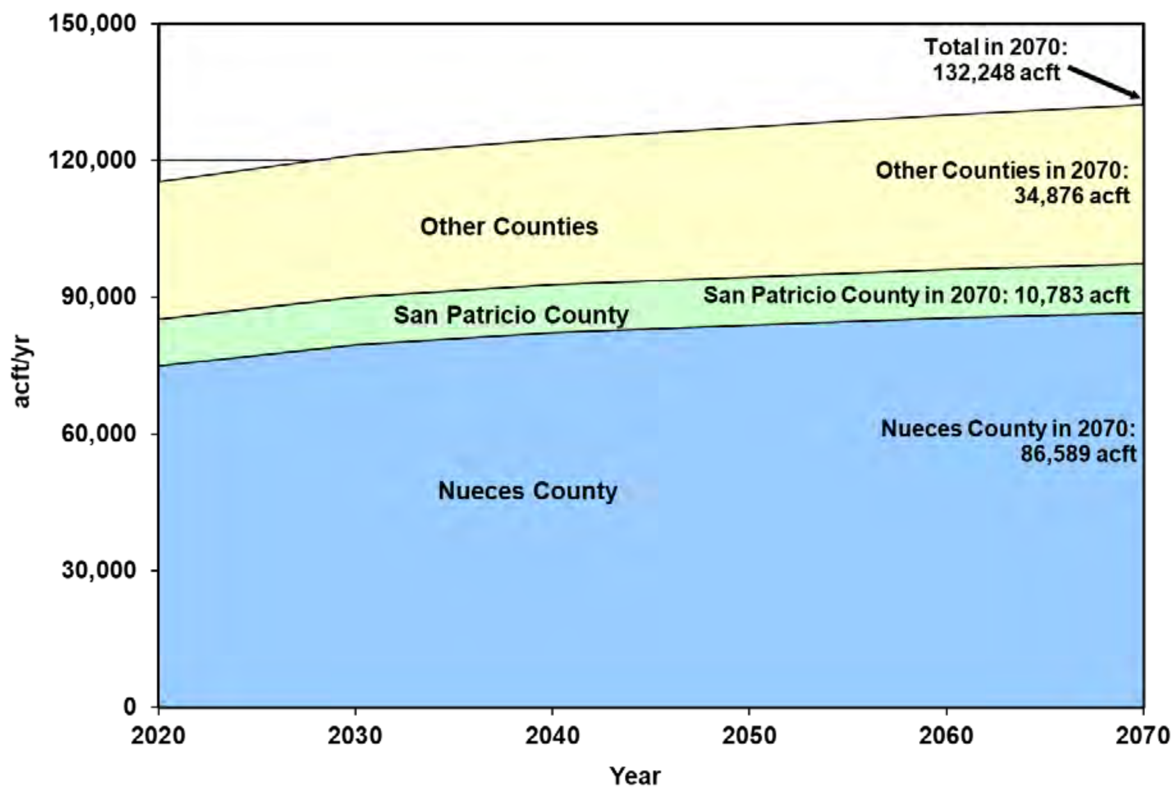


Figure 2.6.
Coastal Bend Region Municipal Water Demand

Table 2.5.
Coastal Bend Region Municipal Water Demand by City/County (ac-ft/yr)

City/County	Historical		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas Pass (P)	146	92	132	131	127	126	126	126
Rockport	1,357	1,422	3,462	3,469	3,410	3,404	3,398	3,398
County-Other	1,811	2,472	491	480	462	457	455	455
Aransas County	**3,314**	**3,986**	**4,085**	**4,080**	**3,999**	**3,987**	**3,979**	**3,979**
Beeville	2,529	2,333	3,336	3,397	3,394	3,377	3,375	3,376
El Oso (P)	60	80	100	101	101	101	96	96
County-Other	1,631	3,649	1,875	1,900	1,893	1,874	1,872	1,872
Pettus Mud	--	--	104	105	104	103	103	103
TDCJ Chase Field	--	--	1,024	1,050	1,055	1,051	1,050	1,050
Bee County	**4,220**	**6,062**	**6,439**	**6,553**	**6,547**	**6,506**	**6,496**	**6,497**
Falfurrias	1,661	1,346	1,639	1,668	1,703	1,745	1,790	1,852
County-Other	309	496	224	246	269	297	324	341
Brooks County	**1,970**	**1,842**	**1,863**	**1,914**	**1,972**	**2,042**	**2,114**	**2,193**
Freer WCID	624	584	687	712	733	755	776	794
San Diego MUD 1	471	509	747	774	797	824	851	876
County-Other	1,228	854	477	484	490	497	508	516
Duval County CRD	--	--	260	266	271	277	285	291
Duval County	**2,323**	**1,947**	**2,171**	**2,236**	**2,291**	**2,353**	**2,420**	**2,477**
Alice	5,281	3,443	4,494	4,744	4,978	5,267	5,548	5,812
Orange Grove	353	246	476	506	534	566	596	625
Premont	807	437	709	752	791	841	886	928
San Diego (P)	99	128	174	180	186	192	198	204
Jim Wells County FWSD1	--	--	131	141	151	161	170	178
County-Other	2,022	1,939	2,095	2,201	2,303	2,432	2,562	2,687
Jim Wells County	**8,562**	**6,193**	**8,079**	**8,524**	**8,943**	**9,459**	**9,960**	**10,434**
County-Other	46	109	244	260	262	263	263	263
Kenedy County	**46**	**109**	**244**	**260**	**262**	**263**	**263**	**263**
Kingsville	4,440	3,202	4,205	4,453	4,706	4,992	5,301	5,599
Ricardo WSC	296	248	340	361	382	405	430	454
County-Other	679	583	257	272	290	311	331	349
Baffin Bay WSC	--	--	237	253	268	285	303	320
Naval Air Station Kingsville	--	--	256	284	303	327	347	366
Riviera Water System	--	--	114	121	129	137	145	153
Kleberg County	**5,415**	**4,033**	**5,409**	**5,744**	**6,078**	**6,457**	**6,857**	**7,241**
El Oso WSC (P)	189	184	178	174	171	169	160	160
George West	642	471	435	424	414	411	410	410
McCoy WSC	50	50	21	20	20	20	20	20
Three Rivers	425	316	545	530	518	512	511	511
County-Other	684	629	637	622	610	604	602	602
Live Oak County	**1,990**	**1,649**	**1,816**	**1,770**	**1,733**	**1,716**	**1,703**	**1,703**

City/County	Historical		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
County-Other	135	156	97	94	91	89	89	89
McMullen County	**135**	**156**	**97**	**94**	**91**	**89**	**89**	**89**
Aransas Pass	12	2	2	2	2	2	2	2
Bishop	459	443	593	627	645	660	672	681
Corpus Christi	55,629	67,323	64,110	68,180	70,493	71,888	73,258	74,240
Driscoll	97	105	105	110	112	114	116	117
Nueces WSC		143	457	589	668	762	871	999
River Acres WSC [2]	314	357	426	450	462	470	479	485
County-Other	5,214	8,651	1,475	1,604	1,695	1,713	1,708	1,667
Corpus Christi Naval Air Station	--	--	1,085	1,178	1,237	1,271	1,296	1,315
Nueces County WCID 3 [2]	--	--	4,004	3,992	3,952	3,933	3,929	3,928
Nueces County WCID 4	--	--	2,465	2,661	2,782	2,854	2,912	2,951
Violet WSC	--	--	186	193	196	198	201	204
Nueces County	**61,725**	**77,024**	**74,908**	**79,586**	**82,244**	**83,865**	**85,444**	**86,589**
Aransas Pass (P)	1,210	949	1,370	1,391	1,392	1,399	1,414	1,425
Gregory	249	266	339	344	348	354	357	360
Ingleside	873	1,028	1,013	1,024	1,023	1,026	1,036	1,044
Mathis	671	668	653	658	655	661	668	673
Odem	319	235	395	401	401	404	408	411
Portland	1,976	2,046	3,389	3,458	3,477	3,503	3,539	3,569
Rincon WSC		442	368	377	381	385	389	392
Sinton	1,036	1,416	1,345	1,382	1,396	1,411	1,427	1,438
Taft	559	434	540	546	545	552	558	563
County-Other	1,980	1,369	843	856	877	892	900	908
San Patricio County	**8,873**	**8,853**	**10,255**	**10,437**	**10,495**	**10,587**	**10,696**	**10,783**
Total for Region	**98,573**	**111,854**	**115,366**	**121,198**	**124,655**	**127,324**	**130,021**	**132,248**

Note: (P) Partial

[1] Projections from Texas Water Development Board

[2] These entities rely on supplies delivered by Nueces County WCID 3. Nueces County WCID 3 diverts water from the Lower Nueces River and conveys supplies through an unlined canal. By lining the canals, the amount of water necessary for diversion by Nueces County WCID 3 to meet customer needs could be reduced.

2.3.2 Manufacturing Water Demand

Manufacturing is an integral part of the Texas economy, and for many industries, water plays a key role in the manufacturing process. Some of these processes require direct consumption of water as part of the products; others consume very little water but use a large quantity for cleaning and cooling. Whether the water is a product component or used to transport waste heat and materials, it is considered manufacturing water use. According to TWDB studies, over the past two decades, industrial water use in Texas has declined by 60% at the same time that output product has nearly doubled. The water-using manufacturers in the 11-county Coastal Bend Region are food processing, chemicals, petroleum refining, stone and concrete, fabricated metal, and electronic and electrical equipment. Of these industries present in the region, chemicals and petroleum refining are the largest and biggest water users.

The TWDB projected manufacturing water demand for years 2030 through 2070 by using TWDB 2010-2014 historical Water Use Survey data, taking the highest county-aggregated manufacturing water use over the five year period and using as an estimate for 2020 water demand. The most recent 10-year projections for employment growth from the Texas Workforce Commission where then used to approximate growth in the industrial sectors between 2020 and 2030. These growth trends assume expansion of existing capacity, building of new facilities, and continuation of historical trends of interaction between oil price changes and industrial activity. From 2030 to 2070, manufacturing water demand was held constant. Manufacturing growth in Nueces and San Patricio Counties were increased, as reflected in the adopted TWDB projections, based on stakeholder feedback of new industries scheduled to arrive in the Coastal Bend Region over the next few years.

In 2010, total manufacturing water use for Coastal Bend Region was 44,820 ac-ft. Nueces and San Patricio Counties accounted for 91.8 percent of this total (Table 2.6). Manufacturing use is projected to be 88,634 ac-ft in 2020 and 98,480 ac-ft in 2070, an 11 percent increase. In 2070, Nueces and San Patricio Counties are projected to account for 95 percent of the total manufacturing water use in the region (Figure 2.7).

Table 2.6.
Coastal Bend Region Manufacturing Water Demand by County and River Basin (ac-ft/yr)

County	Historical*		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	235	0	0	0	0	0	0	0
Bee	1	0	0	0	0	0	0	0
Brooks	0	0	1	1	1	1	1	1
Duval	0	0	0	0	0	0	0	0
Jim Wells[2]	0	79	79	95	95	95	95	95
Kenedy	0	0	0	0	0	0	0	0
Kleberg[2]	0	1,275	1,809	2,056	2,056	2,056	2,056	2,056
Live Oak	1,767	2,124	2,274	2,493	2,493	2,493	2,493	2,493
McMullen[2]	0	219	219	249	249	249	249	249
Nueces	39,763	33,517	45,411	50,363	50,363	50,363	50,363	50,363
San Patricio	12,715	7,606	38,841	43,223	43,223	43,223	43,223	43,223
Total for Region	**54,481**	**44,820**	**88,634**	**98,480**	**98,480**	**98,480**	**98,480**	**98,480**

Note: *Self-reported use

[1] Projections from Texas Water Development Board

[2] Historical manufacturing water demands were reported for Jim Wells, Kleberg, and McMullen counties but not included in TWDB demand projections from 2020-2070. According to TWDB staff, mining and manufacturing demands are often considered interchangeably. No manufacturing water use was reported for Jim Wells County in 2013. In future water planning cycles, manufacturing water demands for Jim Wells, Kleberg, and McMullen counties should be revisited to avoid underestimating supplies that might be needed.

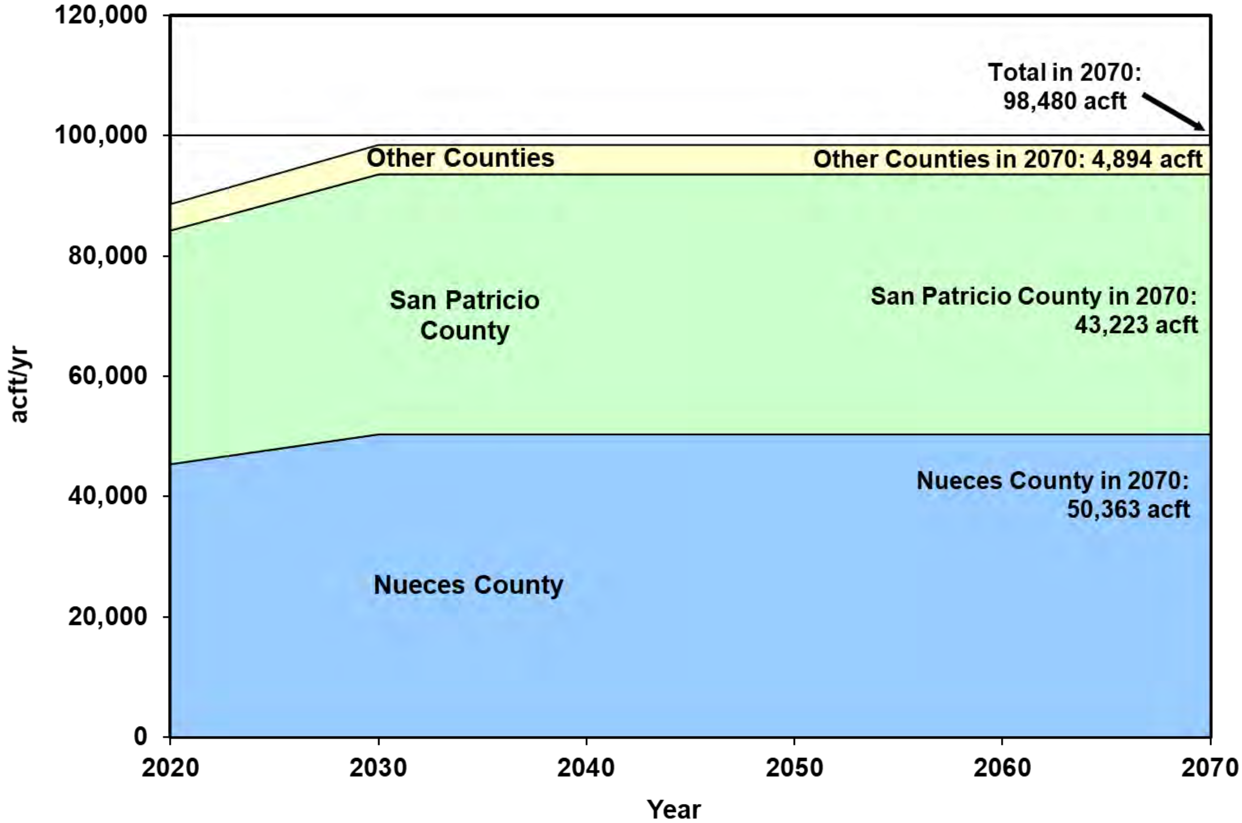


Figure 2.7.
Coastal Bend Region Manufacturing Water Demand

Petroleum refining is one of the largest industries in the region, accounting for about 60 percent of all manufacturing water use. Corpus Christi, in Nueces County, is home to nearly 13 percent of Texas' petroleum refining capacity. The refineries in the Corpus Christi area have implemented significant water conservation and water use efficiency improvement programs. These refineries use between 35 and 46 gallons of water per barrel of crude petroleum refined, compared to the State average of 100 gallons per barrel refined.[3]

2.3.3 Steam-Electric Water Demand

The TWDB projected steam-electric water demands by using TWDB 2010-2014 historical Water Use Survey data, taking the highest county-aggregated steam-electric power water use over the five year period and using as an estimate for 2020 water demand. The anticipated water use of future facilities from state and federal reports was added based on anticipated operation date to 2070. The reported water use of facilities scheduled to retire according to state and federal

[3] "Report of Water Use for Refineries and Selected Cities in Texas, 1976-1987," South Texas Water Authority, Kingsville, Texas, 1990.

reports was subtracted from the demand projections. From 2020 to 2070, steam-electric water demands are held constant.

Only two Region N counties report steam-electric water demands, Nueces and San Patricio Counties. Projections for steam-electric power water demand are based on power generation projections — determined by population and manufacturing growth — and on generating capacity and water use for that projected capacity. The steam-electric generation process uses water in boilers and for cooling the generating equipment. The usual practice is to use freshwater with a very low concentration of dissolved solids for boiler feed water and to use either freshwater or saline water for power plant cooling purposes. At two of the three plants located in Corpus Christi in Nueces County, freshwater is used for the boiler feed and seawater is used for cooling. The Nueces Bay Power Station is not currently operating. The use of saltwater for cooling at Topaz (formerly AEP-CPL's) Barney Davis Power Station saves approximately 6,300 ac-ft/yr in freshwater (1999 figures). At the third plant, Lon C. Hill, fresh water is used for the boiler feed and cooling. Table 2.7 shows that in 2010, 388 ac-ft/yr of water was used. The 388 ac-ft/yr figure is self-reported and downloaded from the TWDB water use survey in 2015. It should be noted that this value is only 5% of the reported value in 2000 of 8,799 ac-ft/yr, and may be an anomaly. According to AEP[4], approximately two-thirds of water used in Year 2000 was forced evaporation of saltwater. In 2070, steam-electric demands for freshwater are projected to be 3,996 ac-ft/yr (Figure 2.8). For projected water demands from 2020 to 2070, the projected fresh water use is estimated to be over three-quarters of the total projected steam-electric water demand.[5]

Table 2.7.
Coastal Bend Region Steam-Electric Water Demand by County and River Basin (ac-ft/yr)

County	Historical*		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	0	0	0	0	0	0	0	0
Bee	0	0	0	0	0	0	0	0
Brooks	0	0	0	0	0	0	0	0
Duval	0	0	0	0	0	0	0	0
Jim Wells	0	0	0	0	0	0	0	0
Kenedy	0	0	0	0	0	0	0	0
Kleberg	0	0	0	0	0	0	0	0
Live Oak	0	0	0	0	0	0	0	0
McMullen	0	0	0	0	0	0	0	0
Nueces	8,799	388	2,077	2,077	2,077	2,077	2,077	2,077
San Patricio	0	0	1,919	1,919	1,919	1,919	1,919	1,919
Total for Region	**8,799**	**388**	**3,996**	**3,996**	**3,996**	**3,996**	**3,996**	**3,996**

[1] Projections from Texas Water Development Board. Self-reported use.

[4] Correspondence with Greg Carter, AEP-CPL.
[5] TWDB, "Power Generation Water Use in Texas for the Years 2000 through 2070", January 2003.

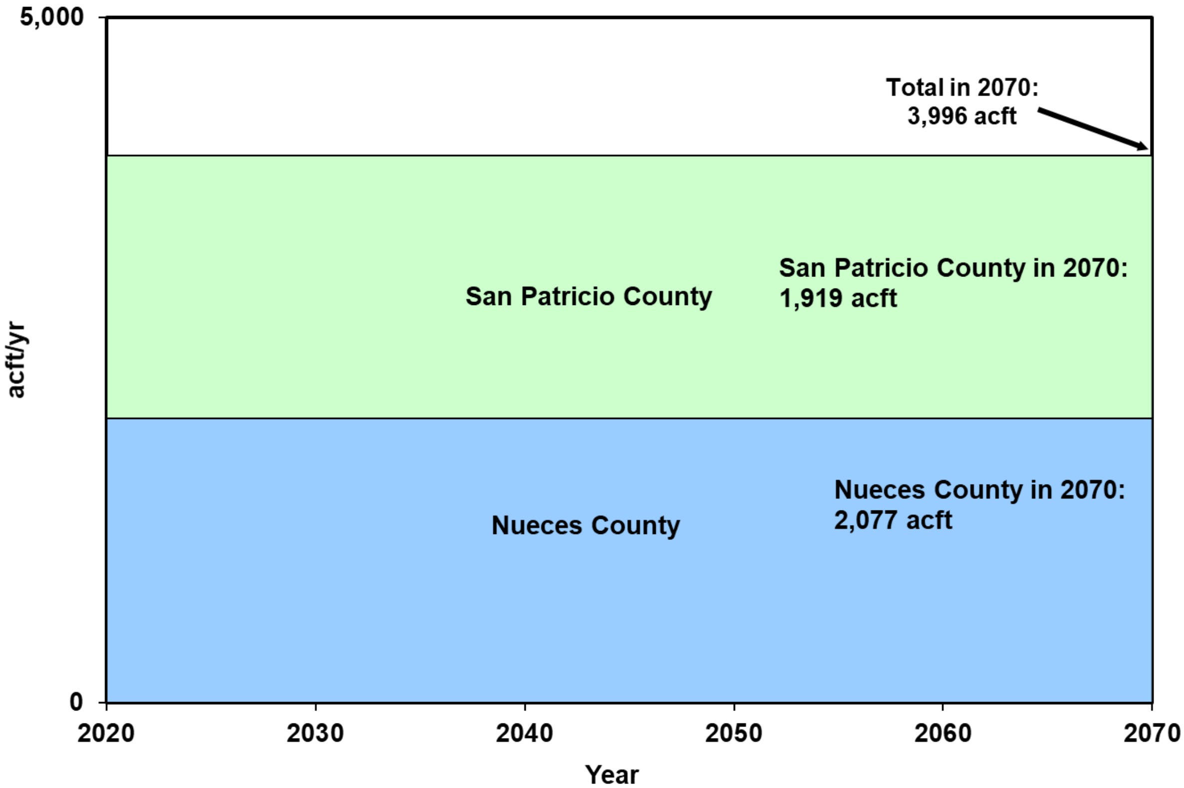


Figure 2.8.
Coastal Bend Region Steam-Electric Water Demand

2.3.4 Mining Water Demand

Projections for mining water demand are based on projected production of mineral commodities, and historic rates of water use, moderated by water requirements of technological processes used in mining.

The development of natural gas from the shale in the Eagleford Group is active in several counties in the Coastal Bend Region, especially Live Oak and McMullen Counties. Water demands associated with these mining activities impacts local groundwater use. For the 2016 Region N Plan, the Coastal Bend Regional Water Planning Group prepared alternate mining water demand projections for McMullen and Live Oak counties to account for increased potential future Eagleford activities through Year 2040 based on information from local groundwater conservation districts. These higher alternate mining water demand projections were approved by the TWDB for planning use, and continue for use in the 2021 Region N Plan, as shown in Table 2.8. Uranium mining is in the initial phases of exploration in Live Oak County and is anticipated to use additional groundwater supplies. The impacts of developing gas wells in the Eagleford shale and uranium mining activities on groundwater supplies in the Coastal Bend Region should continue to be considered in future planning efforts.

Table 2.8.
Coastal Bend Region Mining Water Demand by County and River Basin (ac-ft/yr)

County	Historical*		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	81	19	10	7	5	5	5	5
Bee	29	384	472	458	428	372	338	318
Brooks	127	334	357	360	340	324	308	298
Duval	4,544	1,594	1,388	1,444	1,352	1,241	1,165	1,104
Jim Wells	347	49	71	74	55	40	26	17
Kenedy	1	82	118	123	92	68	43	27
Kleberg	2,627	558	357	360	340	324	308	298
Live Oak	3,105	118	814	917	907	729	492	332
McMullen	176	440	4,268	4,804	4,754	2,622	1,850	1,305
Nueces	1,275	1,369	724	853	947	1,021	1,130	1,260
San Patricio	85	308	372	421	440	460	492	533
Total for Region	**12,397**	**5,255**	**8,951**	**9,821**	**9,660**	**7,206**	**6,157**	**5,497**

Note: * Self-reported use.
[1] Projections from Texas Water Development Board

In 2010 for the 11 counties of the Coastal Bend Planning Area, 5,255 ac-ft was used in the mining of sand, gravel, production of crude oil, and possibly mineral/uranium exploration. Water is required in the mining of these minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation. Duval, McMullen and Nueces Counties accounted for 71.3 percent of the 2020 total use (Table 2.8). Mining water use in 2020 is expected to be 8,951 ac-ft and is projected to increase 7.9 percent to 9,660 ac-ft in 2040 before decreasing 43 percent to 5,497 from 2040 to 2070. Duval, McMullen, and Nueces, will account for 66.7 percent of the 2070 total use (Figure 2.9). The drop in projected demands is attributable to estimates of Eagleford activities slowing down after 2040, however future trends are difficult to predict considering technology enhancements and energy market.

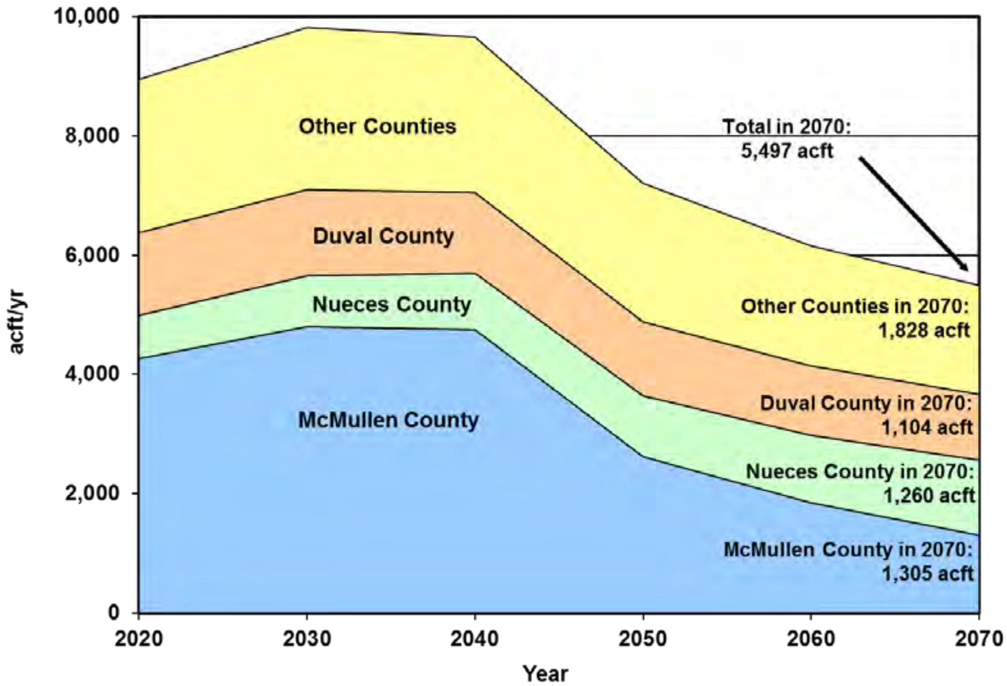


Figure 2.9.
Coastal Bend Region Mining Water Demand

2.3.5 Irrigation Water Demand

Irrigated crop production in Coastal Bend Region is projected in 8 of the 11 counties. Irrigation survey data provided by the Texas Water Development Board reported 27,336 acres of irrigated farmland in 2010 for the Coastal Bend Region, with over 99 percent irrigated with groundwater. In 2017, about 14,780 ac-ft of water was used to irrigated 26,210 acres in Region N. Major crops include corn, cotton, sorghum, hay and vegetables.

The irrigation water demand projections are based on specific assumptions regarding crop prices, crop yields, agricultural policy, and technological advances in irrigation systems. The TWDB estimated 2020 total irrigated water use in the Coastal Bend Region at 30,206 ac-ft based on self-reported irrigation water use surveys (Table 2.9). Bee and San Patricio Counties accounted for 63 percent of that total. Irrigated water use is projected to remain constant from 2020 to 2070 at 30,206 ac-ft (Figure 2.10). It should be noted that in Bee and Live Oak Counties, most irrigation occurs in the southern portion of those counties in the more productive Evangeline layers of the Gulf Coast Aquifer.

Table 2.9.
Coastal Bend Region Irrigation Water Demand by County and River Basin (ac-ft/yr)

County	Historical*		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	0	0	0	0	0	0	0	0
Bee	2,798	4,425	4,425	4,425	4,425	4,425	4,425	4,425
Brooks	25	803	1,161	1,161	1,161	1,161	1,161	1,161
Duval	4,524	1,642	4,042	4,042	4,042	4,042	4,042	4,042
Jim Wells	3,731	1,574	1,913	1,913	1,913	1,913	1,913	1,913
Kenedy	107	0	0	0	0	0	0	0
Kleberg	1,002	576	850	850	850	850	850	850
Live Oak	3,539	700	1,630	1,630	1,630	1,630	1,630	1,630
McMullen	0	0	0	0	0	0	0	0
Nueces	1,680	1,503	1,540	1,540	1,540	1,540	1,540	1,540
San Patricio	4,565	7,175	14,645	14,645	14,645	14,645	14,645	14,645
Total for Region	**21,971**	**18,398**	**30,206**	**30,206**	**30,206**	**30,206**	**30,206**	**30,206**

Note: * Self–reported use.
[1] Projections from Texas Water Development Board

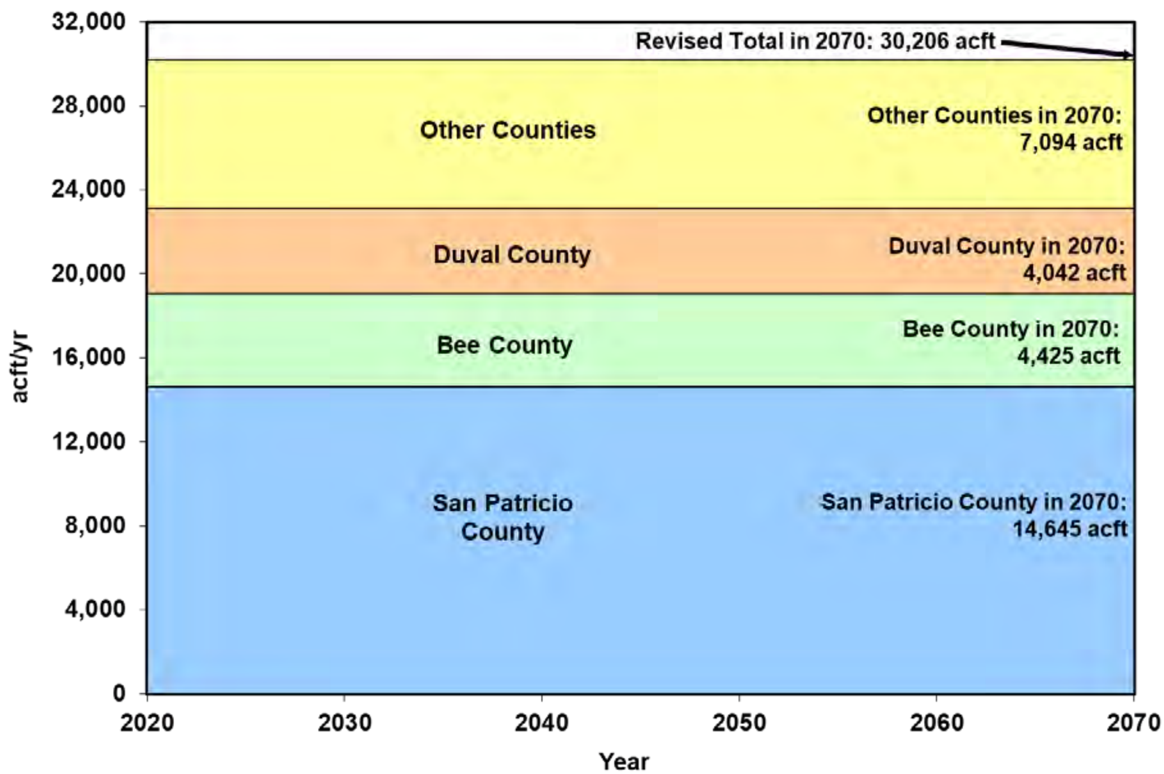


Figure 2.10.
Coastal Bend Region Irrigation Water Demand

2.3.6 Livestock Water Demand

In the 11-county Coastal Bend Region, the principal livestock type is beef cattle, with some dairy herds. Livestock drinking water is obtained from wells, stock watering tanks that are dug/ constructed on the ranches, and streams that flow through the ranches.

The livestock water demand projections are based on estimates of the maximum carrying capacity of the rangeland of the area and the estimated number of gallons of water per head of livestock per day. In 2010, livestock water use for the Coastal Bend region was reported as 7,073 ac-ft: 10.3 percent in Kleberg County, 11.9 percent in Kenedy County, 15.9 percent in Jim Wells County, 13.8 percent in Bee County, and 45.7 percent in the remaining counties. From 2020 to 2070, water use for livestock use is projected by the TWDB to remain constant at 6,065 ac-ft (Table 2.10 and Figure 2.11).

Table 2.10.
Coastal Bend Region Livestock Water Demand by County and River Basin (ac-ft/yr)

County	Historical*		Projections[1]					
	2000	2010	2020	2030	2040	2050	2060	2070
Aransas	23	63	56	56	56	56	56	56
Bee	995	1,147	834	834	834	834	834	834
Brooks	747	449	463	463	463	463	463	463
Duval	873	710	640	640	640	640	640	640
Jim Wells	1,064	1,122	902	902	902	902	902	902
Kenedy	901	840	735	735	735	735	735	735
Kleberg	1,900	726	673	673	673	673	673	673
Live Oak	833	779	740	740	740	740	740	740
McMullen	659	464	335	335	335	335	335	335
Nueces	279	324	291	291	291	291	291	291
San Patricio	564	449	396	396	396	396	396	396
Total for Region	**8,838**	**7,073**	**6,065**	**6,065**	**6,065**	**6,065**	**6,065**	**6,065**

Note: * Self-reported use.
[1] Projections from Texas Water Development Board

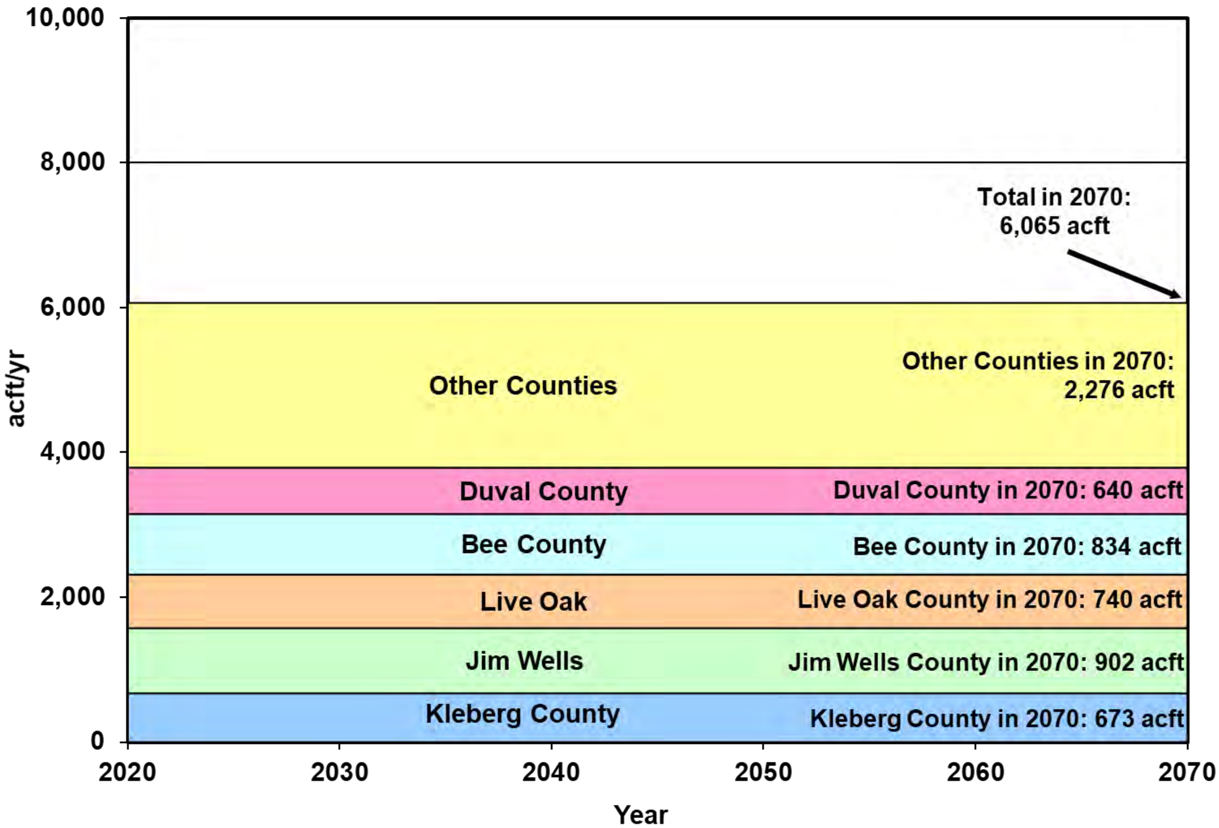


Figure 2.11.
Coastal Bend Region Livestock Water Demand

2.4 Water Demand Projections for Major Water Providers

There are four current regional wholesale water providers (WWPs) in the Coastal Bend Region: the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID 3. These four WWPs were designated by the CBRWPG as major water providers (MWPs) on November 9, 2017. The City of Corpus Christi provides water to SPMWD and STWA, as shown in Table 2.11. The City of Corpus Christi is contracted to provide up to 73,800 ac-ft/yr to SPMWD (46,800 ac-ft/yr of raw water and 27,000 ac-ft/yr of treated water supplies after Year 2020) and meet demands of STWA and their customers. For the 2021 Plan, water supply constraints are considered based on system yield (raw water) or water treatment plant capacity (treated water), whichever is the most constraining. Accordingly, the water demands for each WWP and their customers are shown in Table 2.11 and are categorized according to raw or treated water demands for ease of comparison to supplies discussed in Chapters 3 and 4. The City of Corpus Christi and SPMWD provide both raw and treated water supplies to their customers. STWA solely provides treated water supplies to its customers. Nueces County WCID 3 provides treated water supplies to its customers. Two potential future WWP were identified for recommended water management strategies: the Port of Corpus Christi Authority (PCCA) and Poseidon Water. However, because they are not current MWPs they are not included in the table.

Table 2.11.
Coastal Bend Region Water Demand Projections for Current Major Water Providers

Major Water Provider (Water User/County)	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
CITY OF CORPUS CHRISTI						
Raw Water Demand						
Municipal						
Jim Wells County						
City of Alice	4,494	4,744	4,978	5,267	5,548	5,812
Bee County						
City of Beeville[1]	1,925	1,986	1,983	1,966	1,964	1,965
San Patricio County						
City of Mathis	653	658	655	661	668	673
San Patricio MWD *(based on water supply contract)*	38,084	46,800	46,800	46,800	46,800	46,800
Live Oak County						
City of Three Rivers	3,363	3,363	3,363	3,363	3,363	3,363
Non-Municipal						
Nueces County						
Manufacturing	2,232	9,912	9,912	9,912	9,912	9,912
Steam Electric	2,077	2,077	2,077	2,077	2,077	2,077
Total Raw Water Demand	**52,828**	**69,540**	**69,768**	**70,046**	**70,332**	**70,602**
Treated Water Demand						
Nueces County						
Nueces County WCID 4	1,134	1,224	1,280	1,313	1,340	1,357
City of Corpus Christi	64,110	68,180	70,493	71,888	73,258	74,240
Corpus Christi Naval Air Station	1,085	1,178	1,237	1,271	1,296	1,315
Violet WSC	186	193	196	198	201	204
San Patricio County						
San Patricio MWD	15,592	27,000	27,000	27,000	27,000	27,000
Kleberg County						
South Texas Water Authority *(based on water supply contract)*	1,875	2,170	2,341	2,530	2,994	3,331
Non-Municipal						
Manufacturing (Nueces County)	41,190	38,436	38,436	38,436	38,436	38,436
Total Treated Water Demand	**125,172**	**138,381**	**140,983**	**142,636**	**144,525**	**145,883**
Total Water Demand	**178,000**	**207,921**	**210,751**	**212,682**	**214,857**	**216,485**
River Basin						
Nueces	19,812	20,014	20,358	20,573	20,786	20,937
Nueces- Rio Grande	102,587	112,121	114,610	116,343	118,307	119,783
San Antonio- Nueces	55,601	75,786	75,783	75,766	75,764	75,765
Total Water Demand	**178,000**	**207,921**	**210,751**	**212,682**	**214,857**	**216,485**

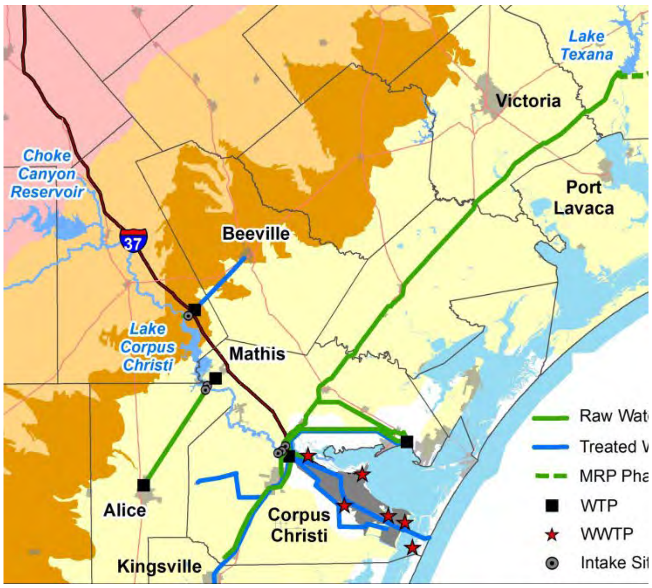
Major Water Provider (Water User/County)	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Raw Water Demand						
San Patricio County						
Non-Municipal						
Manufacturing (*San Patricio County*)	9,704	10,800	10,800	10,800	10,800	10,800
Steam-Electric (*San Patricio County*)	1,919	1,919	1,919	1,919	1,919	1,919
Total Raw Water Demand	**11,623**	**12,719**	**12,719**	**12,719**	**12,719**	**12,719**
Treated Water Demand						
Municipal						
Nueces County						
City of Aransas Pass	2	2	2	2	2	2
Nueces County WCID 4	1,331	1,437	1,502	1,541	1,572	1,594
County-Other[1]	98	106	112	113	113	110
San Patricio County						
City of Aransas Pass	1,370	1,391	1,392	1,399	1,414	1,425
City of Gregory	339	344	348	354	357	360
City of Ingleside	1,013	1,024	1,023	1,026	1,036	1,044
City of Odem	395	401	401	404	408	411
City of Portland	3,389	3,458	3,477	3,503	3,539	3,569
Rincon WSC	368	377	381	385	389	392
City of Taft	540	546	545	552	558	563
County-Other[1,2]	639	649	666	677	683	690
Aransas County						
City of Aransas Pass	132	131	127	126	126	126
City of Rockport	3,462	3,469	3,410	3,404	3,398	3,398
County-Other[1]	120	118	113	112	112	112
Municipal Treated Water Demand	**13,198**	**13,453**	**13,499**	**13,598**	**13,707**	**13,796**
Non-Municipal						
Manufacturing (*San Patricio County*)	28,664	31,951	31,951	31,951	31,951	31,951
Industrial Treated Water Demand	**28,664**	**31,951**	**31,951**	**31,951**	**31,951**	**31,951**
Total Water Demand	**53,485**	**58,123**	**58,169**	**58,268**	**58,377**	**58,466**
Nueces	–	–	–	–	–	–
Nueces- Rio Grande	–	–	–	–	–	–
San Antonio- Nueces	53,485	58,123	58,169	58,268	58,377	58,466
Total Water Demand	**53,485**	**58,123**	**58,169**	**58,268**	**58,377**	**58,466**

Major Water Provider (Water User/County)	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Municipal						
Nueces County						
Driscoll	105	110	112	114	116	117
Bishop[1]	311	345	363	378	390	399
Nueces WSC	457	589	668	762	871	999
County-Other, Nueces[3]	199	217	234	247	260	272
Kleberg County						
Kingsville + County-Other[1]	463	548	582	624	927	1,090
Ricardo WSC	340	361	382	405	430	454
Total Water Demand (All Treated)	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**
Nueces	45	58	66	76	87	99
Nueces- Rio Grande	1,830	2,112	2,275	2,454	2,907	3,232
San Antonio- Nueces						
Total Water Demand	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**
Nueces County						
Nueces County WCID 3	4,004	3,992	3,952	3,933	3,929	3,928
River Acres WSC	426	450	462	470	479	485
Total Water Demand (All Treated)	**4,430**	**4,442**	**4,414**	**4,403**	**4,408**	**4,413**
Nueces	426	450	462	470	479	485
Nueces- Rio Grande	4,004	3,992	3,952	3,933	3,929	3,928
San Antonio- Nueces						
Total Water Demand	**4,430**	**4,442**	**4,414**	**4,403**	**4,408**	**4,413**

[1] Wholesale water provider does not meet full demand (i.e. additional supply from groundwater)

[2] Includes Taft Southwest, and Seaboard WSC.

[3] Includes Coastal Bend Youth City, KB Foundation, Geo Center, and Nueces County WCID #5.



3

Water Supply Analysis

[31 TAC §357.32]

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Chapter 3: Water Supply Analysis

3.1 Surface Water Supplies

The Coastal Bend Region is located within three river basins: the Nueces River Basin, the San Antonio-Nueces Coastal Basin, and the Nueces-Rio Grande Coastal Basin (Figure 3.1). Streamflows in the two coastal basins are highly variable and intermittent and do not supply large quantities of water except during high rainfall conditions. However, streamflow in the Nueces River and its tributaries, along with municipal and industrial water rights in the Nueces River Basin, comprise a significant supply of water used in the Coastal Bend Region, as this basin drains about 17,000 square miles. These water rights provide authorization for an owner to divert, store and use the water; however, it does not guarantee that a dependable supply will be available from their source. Supply associated with a given water right is dependent on several factors including hydrologic conditions (i.e. rainfall, runoff, springflows), priority date of the water right, quantity of authorized storage, and any special conditions associated with the water right (e.g., instream flow conditions, maximum diversion rate). Because the Nueces River Basin is subject to periods of significant drought and low flows, storage is very important to "firm up" water rights.

3.1.1 Texas Water Right System

The State of Texas owns the surface water within the state watercourses and is responsible for the appropriation of these waters. Surface water is currently allocated by the Texas Commission on Environmental Quality (TCEQ) for the use and benefit of all people of the State. Texas water law is based on the riparian and prior appropriation doctrines. The riparian doctrine extends from the Spanish and Mexican governments that ruled Texas prior to 1836. After 1840, the riparian doctrine provided landowners the rights to make reasonable use of water for irrigation or for other consumptive uses. In 1889, the prior appropriation doctrine was first adopted by Texas, which is based on the concept of "first in time is first in right". Over the years, the riparian and prior appropriation doctrines resulted in a system that was very difficult to manage. Various types of water rights existed simultaneously and many rights were unrecorded. In 1967, the Texas Legislature passed the Water Rights Adjudication Act that merged the riparian water rights into the prior appropriation system, creating a unified water permit system.

The adjudication process took many years, stretching into the late 1980s before it was finally completed. In the end, Certificates of Adjudication were issued for entities recognized as having legitimate water rights. Today, individuals or groups seeking a new water right must submit an application to the TCEQ. The TCEQ determines if the water right will be issued and under what conditions. The water right grants a certain quantity of water to be diverted and/or stored, a priority date, and often comes with some restrictions on when and how the right may be utilized. Restrictions may include a maximum diversion rate and/or an instream flow restriction to protect existing water rights and provide environmental protection.

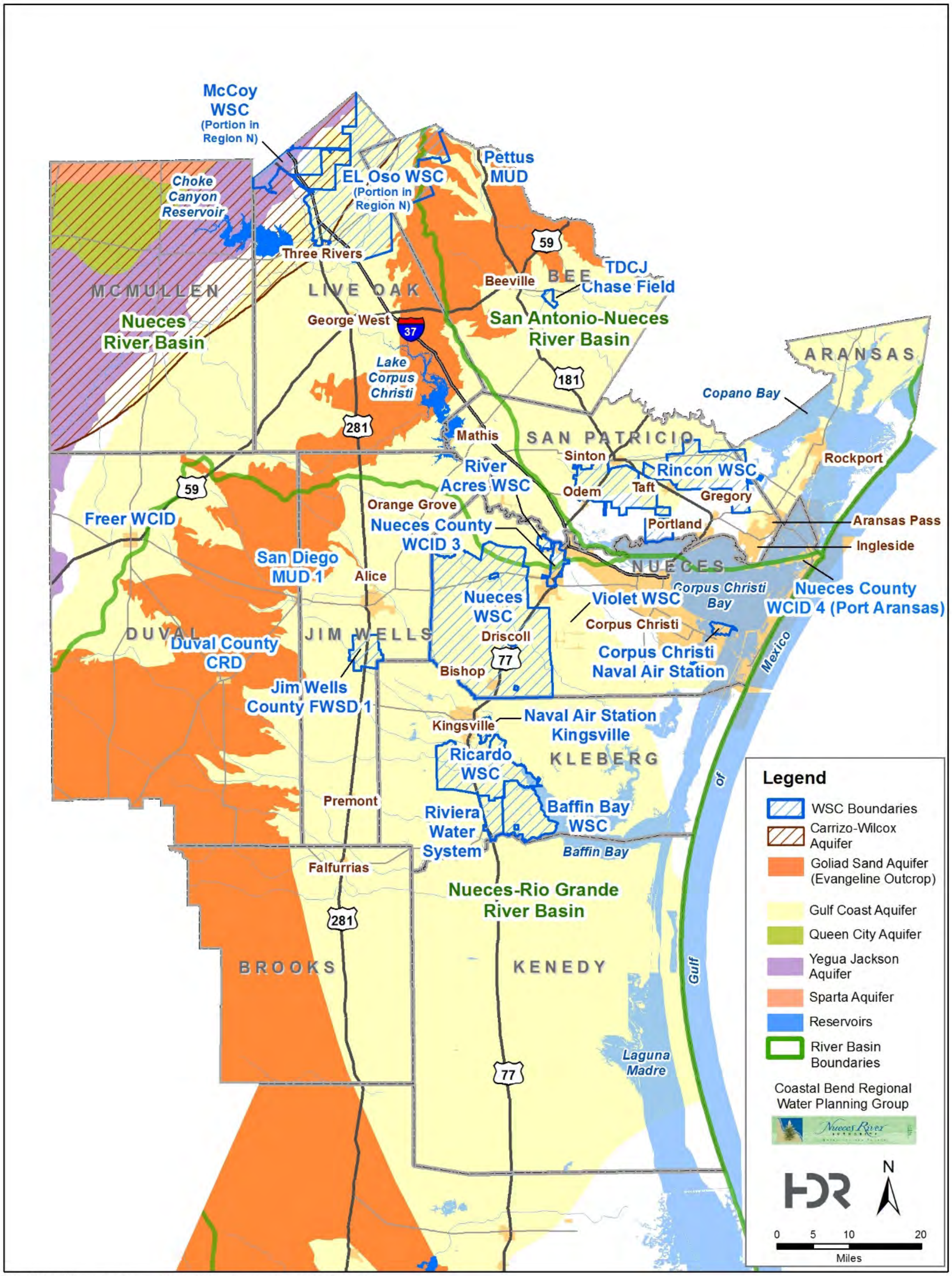

Figure 3.1.
Watershed Boundaries and Aquifer Location Map

The priority date of a water right is essential to the operation of the water rights system. Each right is issued a priority date based on the date of first capture, or the appropriation date. The established priority system must be adhered to by all water right holders when diverting or storing water for use. A right holder must pass all water to downstream senior water rights when conditions are such that the senior water rights would not be satisfied otherwise. Other restrictions may include a maximum diversion rate and instream flow restrictions to protect existing water rights and provide environmental flows for instream needs and needs of estuary systems promulgated by Senate Bill 3, although most water rights issued prior to 1985 do not include such conditions. An important exception to the rule is Certificate of Adjudication Number (CA#) 21-3214 for Choke Canyon Reservoir, which represents approximately 75% of the Nueces River Basin water rights and requires instream flows and freshwater flows for the Nueces Estuary. Operations of the CCR/LCC System are governed, in part, by CA #21-3214, within which Special Conditions B and E state:

B. (Part)
"Owners shall provide not less than 151,000 ac-ft of water per annum for the estuaries by a combination of releases and spills from the reservoir system at Lake Corpus Christi Dam and return flows to the Nueces and Corpus Christi Bays and other receiving estuaries."

E.
"Owners shall continuously maintain a minimum flow of 33 cubic feet per second below the dam at Choke Canyon Reservoir."

Special Condition B of CA #21-3214 further states:
"Water provided to the estuaries from the reservoir system under this paragraph shall be released in such quantities and in accordance with such operational procedures as may be ordered by the Commission."

Hence, the certificate provided for a means to further establish specific rules governing operations of the CCR/LCC System with respect to maintaining freshwater inflows to the Nueces Estuary.

To address concerns about the health of the Nueces Estuary, a Technical Advisory Committee (TAC) chaired by the TCEQ was formed in 1990 to establish operational guidelines for the CCR/LCC System and desired monthly freshwater inflows to the Nueces Estuary. These operational guidelines were summarized in the 1992 Interim Order.[1]

The 1992 Interim Order established a monthly schedule of desired freshwater inflows to Nueces Bay to be satisfied by spills, return flows, runoff below Lake Corpus Christi, and/or dedicated releases from the CCR/LCC System. Mechanisms for relief from reservoir releases under the Interim Order were based on inflow banking, monthly salinity variation in upper Nueces Bay, and implementation of drought contingency measures tied to CCR/LCC System Storage.

The Nueces Estuary Advisory Council (NEAC) was formed under the 1992 Interim Order and charged with continued study of the interdependent relationship between the firm yield of the

[1] Texas Water Commission, Interim Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, held by the City of Corpus Christi, et al., March 9, 1992.

CCR/LCC System and the health of the Nueces Estuary. One of NEAC's primary goals was to evaluate the 1992 Interim Order and other alternative release policies and recommend a more permanent reservoir operations plan for providing freshwater inflows to the Nueces Estuary. This goal was to be achieved within 5 years of NEAC's formation.

The goal of recommending a more permanent reservoir operations plan was fulfilled on April 28, 1995, when the TCEQ issued an order regarding reservoir operations for freshwater inflows to the Nueces Estuary, known as the 1995 Agreed Order.[2] This Agreed Order is very similar to the Interim Order, with one major exception — monthly releases (pass-throughs) to the estuary were limited to CCR/LCC System inflows and stored water is not required to meet estuary freshwater flow needs.

On April 17, 2001, the TCEQ issued an amendment to the 1995 Agreed Order to revise operational procedures in accordance with revisions requested by the City of Corpus Christi. Changes included: 1) passage of inflows to Nueces Bay and Estuary at 40 percent and 30 percent reservoir system capacity upon institution of mandatory outdoor watering restrictions; 2) calculating reservoir system storage capacity based on most recently completed bathymetric surveys; and 3) provisions for operating Rincon Bayou diversions and conveyance facility from Calallen Pool to enhance the amount of freshwater to the Nueces Bay and Delta.

All CCR/LCC/Texana/MRP Phase II System yield analyses and water availability results used in this plan were evaluated based on the current operation conditions in accordance with 2001 Agreed Order provisions.

3.1.2 Types of Water Rights

There are various types of water rights. Water rights are characterized as Certificates of Adjudication, permits, short-term permits, or temporary permits. Certificates of Adjudication were issued in perpetuity for approved claims during the adjudication process. This type of water right was issued based on historical use rather than water availability. As a consequence, the amount of water to which rights on paper are entitled to generally exceeds the amount of water available during a drought for some streams.

The TCEQ issues new permits only where drought flows are sufficient to meet the requested amount. Permits, like Certificates of Adjudication, are issued in perpetuity and may be bought and sold like other property interests. Term permits may be issued by the TCEQ in areas where waters are fully appropriated, but not yet being fully used. Term permits are usually issued for 10 years and may be renewed if, after 10 years, other water right holders are still not fully utilizing the water in the basin. Temporary permits are issued for up to 3 years. Temporary permits are issued mainly for road construction projects, where water is used to suppress dust, to compact soils, and to start the growth of new vegetation. As term and temporary permits are

[2] Texas Commission on Environmental Quality (TCEQ), Agreed Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, held by City of Corpus Christi, et al., April 28, 1995.

not permanent water rights, they are not considered in the process of determining available water supplies.

Water rights can include the right to divert and/or store the appropriated water. A run-of-river water right provides for the diversion of streamflows and generally does not include a significant storage volume for use during dry periods. A run-of-river right may be limited by actual streamflow availability, priority date, pumping rate, or diversion location.

Water rights, which include provisions for storage of water, allow a water right holder to impound streamflows for use at a later time. The storage provides water for use during dry periods, when water may not be available due to hydrologic conditions or because flows are required to be passed to downstream senior water rights.

While most water rights are diverted and used within the river basin of origin, water rights that divert from one river basin to another basin require an interbasin transfer permit. Several types of transfers that receive special consideration and simplified process include emergency transfers, transfers of water from a river basin for use in an adjoining coastal basin (such as from the Nueces River Basin to either the San Antonio-Nueces or the Nueces-Rio Grande Coastal Basins), diversions of less than 3,000 ac-ft/yr, and diversions within any city or county that has any portion in the basin of origin.

The annual availability of a water right is typically considered in terms of firm yield or safe yield supply. The TWDB guidelines[3] state that surface water availability for regional water planning must use firm yield evaluated using TCEQ's Water Availability Model[4] *unless a hydrologic variance approval is granted by the TWDB Executive Administrator for variations in modeling requirements*. Firm yield (for a reservoir) is defined as the maximum water volume a reservoir can provide each year under a repeat of a drought of record, using anticipated sedimentation rates and assuming all senior rights are utilized and no return flows are included such that the reservoir storage draws down to zero or some other defined dead pool storage with no shortages. The firm yield of a run-of-the-river diversion is defined in two ways by the TWDB for use in regional planning. For municipal sole-source water users, the firm yield of a run-of-the-river diversion is defined as "the minimum monthly diversion amount that is available 100 percent of the time during a repeat of the drought of record." For all other water users, the firm diversion is defined as "the minimum annual diversion, which is the lowest annual summation of monthly diversions reported by the WAM over the simulation period representing the calendar year within the simulation that represents the lowest diversion available." The water rights of Nueces County WCID #3 are based on firm yield analyses for municipal sole-source water users.

Safe yield supply represents a more conservative approach to determining minimum annual availability in areas where the severity of droughts is uncertain. Safe yield supply is the amount of water that can be withdrawn from a reservoir such that a given volume remains in reservoir

[3] First Amended General Guidelines for Fifth Cycle of Regional Water Plan Development, April 2017.
[4] Specifically, unmodified WAM Run 3 which includes all water rights at full authorization, all applicable permit conditions, such as flow requirements and no return flows.

storage during the critical month of the drought of record. The surface water availabilities for the largest water rights in the Nueces Basin (i.e. City of Corpus Christi and their customers) are based on safe yield analyses and assume a reserve of 75,000 ac-ft for future drought conditions.[5]

3.1.3 Water Rights in the Nueces River Basin

A total of 325 water rights exist in the Nueces River Basin with a total authorized diversion and consumptive use of 530,346 ac-ft/yr.[6] It is important to note that a small percentage of the water rights make up a large percentage of the authorized diversion volume. In the Nueces River Basin, four water rights (1.2 percent) make up 463,444 ac-ft/yr (87.4 percent) of the authorized diversion volume as shown in Figure 3.2. Of these, three water rights account for 455,444 ac-ft/yr of the 467,172 ac-ft/yr total in the Coastal Bend Region. The remaining 321 water rights primarily consist of small municipal, industrial, irrigation and recharge rights distributed throughout the river basin. Municipal and industrial diversion rights represent 88 percent of all authorized diversion rights in the Nueces River Basin. Based in large part on water stored in the CCR/LCC System, which is subsequently delivered via the Nueces River to Calallen Dam at Corpus Christi for diversion, the City of Corpus Christi and the Nueces River Authority (NRA) hold 95 percent of these municipal and industrial rights in the basin.[7] With the inclusion of the municipal water rights held by the Nueces County WCID #3, diverted from the Nueces River upstream of the Calallen Dam, the Coastal Bend Region includes over 97 percent of the Nueces River Basin municipal and industrial surface water rights permits. Table 3.1 summarizes the surface water rights in the Nueces River Basin included in the Coastal Bend Planning Region.

[5] On August 20, 2017, the Coastal Bend Regional Water Planning Group adopted a 75,000 ac-ft safe yield reserve in storage during the worst, historical drought of record as the basis for determining availability for the Corpus Christi Water Supply System. In January 2018, the TWDB approved safe yield use for planning purposes in the 2021 Plan.
[6] The number of water rights and corresponding authorized diversion amounts are based on the Texas Commission on Environmental Quality's Water Rights Database, November 2019.
[7] The Nueces River Authority's water right is for 20% of Choke Canyon Reservoir.

Major Water Rights*					
Water Right #	**Owner**	**Diversion Rights (acft/yr)**	**Consumptive Rights (acft/yr)**	**Storage Rights**	**Notes**
2464	City of Corpus Christi	304,898	304,898	300,000 1,175	Lake Corpus Christi Calallen Reservoir
3214	City of Corpus Christi, Nueces River Authority	139,000	139,000	700,000	Choke Canyon Reservoir
3082/95	Zavala-Dimmit Co. WCID #1	28,000	28,000	5,361	
2466	Nueces County WCID #3	11,546	11,546	0	
*Authorized Annual Diversions > 10,000 acft. Major water rights information obtained from the TCEQ.					

Figure 3.2.
Location of Major Water Rights in the Nueces River Basin

Table 3.1.
Nueces River Basin Water Rights in the Coastal Bend Region

Water Right No.	Name	Annual Diversion Volume (ac-ft/yr)	Reservoir Storage Capacity (ac-ft)	Priority Date	Type of Use	Facility	County
2464	City of Corpus Christi	304,898	301,175	12/1913[1]	Municipal (51%) Industrial (49%) Irrigation (minimal) Mining (minimal)	Lake Corpus Christi (300,000 ac-ft) and Calallen Dam (1,175 ac-ft)	Nueces
2465A	Realty Traders & Exchange, Inc.	20	580	10/1952	Irrigation		San Patricio
2465B	Wayne Shambo	140	580	10/1952	Irrigation		San Patricio
2466	Nueces Co. WCID #3	11,546	0	2/1909[1]	Municipal (37%) Irrigation (63%)		Nueces
2467	Garnett T. & Patsy A. Brooks	221	0	2/1964	Irrigation		San Patricio
2468	CE Coleman Estate	27	0	2/1964	Irrigation		Nueces
2469	Ila M. Noakes Lindgreen	101	0	2/1964	Irrigation		Nueces
3141	Randy J. Corporron, et al.	8	0	12/1965	Irrigation		McMullen
3142	WL Flowers Machine & Welding Co.	132	100	12/1958	Irrigation		McMullen
3143	Ted W. True, et al.	220	40	12/1958	Irrigation		McMullen
3144	Harold W. Nix, et ux.	0	285	2/1969	Recreation		McMullen
3204	Richard P. Horton	233	0	12/1963	Irrigation		McMullen
3205	Richard P. Horton	103	122	12/1963	Irrigation		McMullen
3206	James L. House Trust	123	0	12/1966	Irrigation		McMullen
3214	Nueces River Authority and City of Corpus Christi, and City of Three Rivers[2]	139,000	700,000	7/1976	Municipal (43%) Industrial (57%) Irrigation (minimal)	Choke Canyon Reservoir	Nueces/ Live Oak
3215	City of Three Rivers[2]	1,500	2,500	9/1914	Municipal (47%) Irrigation (53%)		Live Oak
4402	City of Taft	600	0	9/1983	Irrigation		San Patricio
5065	Diamond Shamrock Refining[3]	0	0	6/1986	Irrigation		Live Oak
5145	San Miguel Electric Co-Op, Inc.	300	335	12/1990	Industrial		McMullen
5736	City of Corpus Christi	8,000		9/2001	Wetlands		San Patricio
	TOTAL	**467,172**					

1 Water right with multiple priority dates. Earliest date shown in table.

2 According to Special Condition 5B Certificate of Adjudication No. 21-3214 (April 26, 1995) and amendment to the 1984 deed and water contract between the City of Three Rivers and the City of Corpus Christi (April 29, 2005), the City of Three Rivers was added to No. 21-3214 with transfer of ownership of 2% of designed storage and firm yield in Choke Canyon in an average amount of 3 MGD. Through this instrument, the City of Three Rivers can directly divert from Choke Canyon Reservoir. In exchange, the City of Three Rivers permanently transferred management, control and coordination responsibility over Water Right No. 21-3215 to the City of Corpus Christi for use in the Frio and Atascosa watersheds. The City of Three Rivers retains water storage rights (No. 21-3215) associated with the current channel dam.

3 Diamond Shamrock irrigation right is used for irrigation from onsite process water return flows. In effect, this permit is for a reuse project.

3.1.4 Coastal Basins

In addition to the Nueces River Basin, the Coastal Bend Regional Planning Area includes portions of two coastal river basins in Texas: the San Antonio-Nueces Coastal Basin and the Nueces-Rio Grande Coastal Basin. The San Antonio-Nueces Coastal Basin is located on the Texas Coast between the Nueces and Guadalupe-San Antonio River Basin. The drainage area of the basin is approximately 2,652 square miles, and it drains surface water runoff into Copano and Aransas Bays. The Nueces-Rio Grande Coastal Basin is located on the southern side of the Coastal Bend Region between the Nueces and Rio Grande Coastal Basins. This basin drains approximately 10,442 square miles into the Laguna Madre Estuary system. Combined, there are 96 water rights in these two coastal basins authorizing diversions of about 1,957,156 ac-ft/yr.[8] Approximately 1,747,200 ac-ft (89 percent) of the combined authorized diversions are from within the Coastal Bend Region Planning Area, and of these rights, 1,726,317 ac-ft (99 percent) are for steam-electric and manufacturing processes from the bays and saline water bodies along the coast most of which are returned back after cooling processes. Most of this water is used for cooling purposes and is returned to the source. Based on the size and locations of the remaining freshwater rights in these coastal basins and on the lack of a major river or reservoir in these basins, there are few of these freshwater rights that are sustainable throughout an extended drought. For this reason, no firm yield supplies were available from the San Antonio-Nueces Coastal Basin or Nueces-Rio Grande Basin to meet water supply needs for water users in the Coastal Bend Region.

3.1.5 Interbasin Transfer Permits

A number of interbasin transfer permits exist in the Coastal Bend Regional Planning Area. These permits include authorizations for diversions from river basins north of the planning region into the Nueces River Basin. Both major interbasin transfer permits provide water to the City of Corpus Christi and include supplies from the Lavaca-Navidad and Colorado River Basins. The City of Corpus Christi benefits from an interbasin transfer permit[9] and a contract with the LNRA to divert 31,440 ac-ft/yr on a firm basis and up to 12,000 ac-ft/yr on an interruptible basis from Lake Texana in the Lavaca-Navidad River Basin to the City's O.N. Stevens Water Treatment Plant.[10] This water is delivered to the City via the Mary Rhodes Pipeline (MRP), which became operational in 1998. In addition, the pipeline delivers MRP Phase II supplies from the Colorado River to the City through a second interbasin transfer permit owned by the City of Corpus Christi. This permit[11] allows the diversion of up to 35,000 ac-ft/yr of run-of-river water on the Colorado River. Analyses of this water right, one of the most senior in the Colorado River Basin, indicate that the 35,000 ac-ft/yr is available from this run-of-river right during the Nueces Basin drought of record

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[8] The number of water rights and corresponding authorized diversion amounts are based on the Texas Commission on Environmental Quality's Water Rights Database, November 2019.
[9] TCEQ, Certificate of Adjudication No. 16-2095C, held by Lavaca-Navidad River Authority and Texas Water Development Board (TWDB), October 21, 1996.
[10] A call-back of 10,400 ac-ft/yr has been exercised by the LNRA for water needs in Jackson County.
[11] TCEQ, Certificate of Adjudication No. 14-5434B, held by the City of Corpus Christi (via the Garwood Irrigation Company), October 13, 1998.

when integrated as part of the Corpus Christi Regional Water Supply System. Table 3.2 summarizes the major inter-basin transfer permits in the region.

Table 3.2.
Summary of Major Interbasin Transfer Permits in the Coastal Bend Region

River Basin of Origin	Name of Interbasin Transfer Permit Holder	Description	Authorized Diversion (ac-ft/yr)	Priority Date
Lavaca-Navidad	LNRA	Transfer from Lake Texana to adjacent river basins including the Nueces River Basin.	43,440[1]	5/1972
Colorado	City of Corpus Christi	Transfer from Garwood Irrigation Co. water right to the City of Corpus Christi.	35,000	11/1900

[1] City of Corpus Christi currently holds a contract with the Lavaca-Navidad River Authority to provide 31,440 ac ft/yr after LNRA call-back and a maximum of 12,000 ac-ft/yr on an interruptible basis from Lake Texana to the City.

3.1.6 Water Supply Contracts

Many entities within the Coastal Bend Region obtain surface water through water supply contracts. These supplies are usually obtained from entities that have surface water rights to provide a specified or unspecified quantity of water each year to a buyer for an established unit price. The City of Corpus Christi is the largest provider of water supply contracts in the Coastal Bend Region. The City of Corpus Christi supplies water from the CCR/LCC System, Lake Texana via the Mary Rhodes Pipeline, and from the Colorado River via MRP Phase II to two major wholesale customers: San Patricio Municipal Water District (SPMWD) and South Texas Water Authority (STWA). Each of these major wholesale customers in turn sells water to other entities within their service area. In addition to the two major wholesale customers, the City of Corpus Christi also provides wholesale raw surface water to a number of industrial customers.

The City of Corpus Christi has contractual obligations to provide consumptive water use plus up to 10% growth each year to City of Alice, City of Beeville, City of Mathis, Port Aransas, Violet WSC, and STWA. The City of Corpus Christi is contracted to provide up to 3,363 ac-ft/yr to City of Three Rivers[12] and up to 73,800 ac-ft/yr to SPMWD[13] (up to 46,800 ac-ft/yr of raw water and 27,000 ac-ft/yr of treated water) after 2020. Furthermore, the City of Corpus Christi provides raw and treated water supplies to meet needs of Manufacturing, Mining, and Steam and Electric water users in Nueces County. SPMWD and STWA meet water needs of their customers (Figure 3.3). Within the Coastal Bend Region, the Nueces County WCID #3 also provides wholesale water supplies through contracts with a number of small municipalities, water supply corporations, and irrigators. Nueces County WCID #3 provides treated water to City of Robstown and River Acres WSC through run-of-the-river rights on the Nueces River.

[12] Through an amendment to the 1984 deed and water contract between the City of Three Rivers and the City of Corpus Christi (April 29, 2005), the City of Three Rivers was added to No. 21-3214 with transfer of ownership of 2% of designed storage and firm yield in Choke Canyon in an average amount of 3 MGD.
[13] An amendment to the water contract was approved by Corpus Christi City Council on August 20, 2019. The amendment increases the SPMWD treated water contract to 27,000 acft after Year 2020, with an additional 10,000 acft/yr reserve with advance notice. This plan assumes total contracted supplies of 73,800 acft/yr after Year 2020.

Figure 3.3 summarizes the major contract relationships in the Coastal Bend Region.

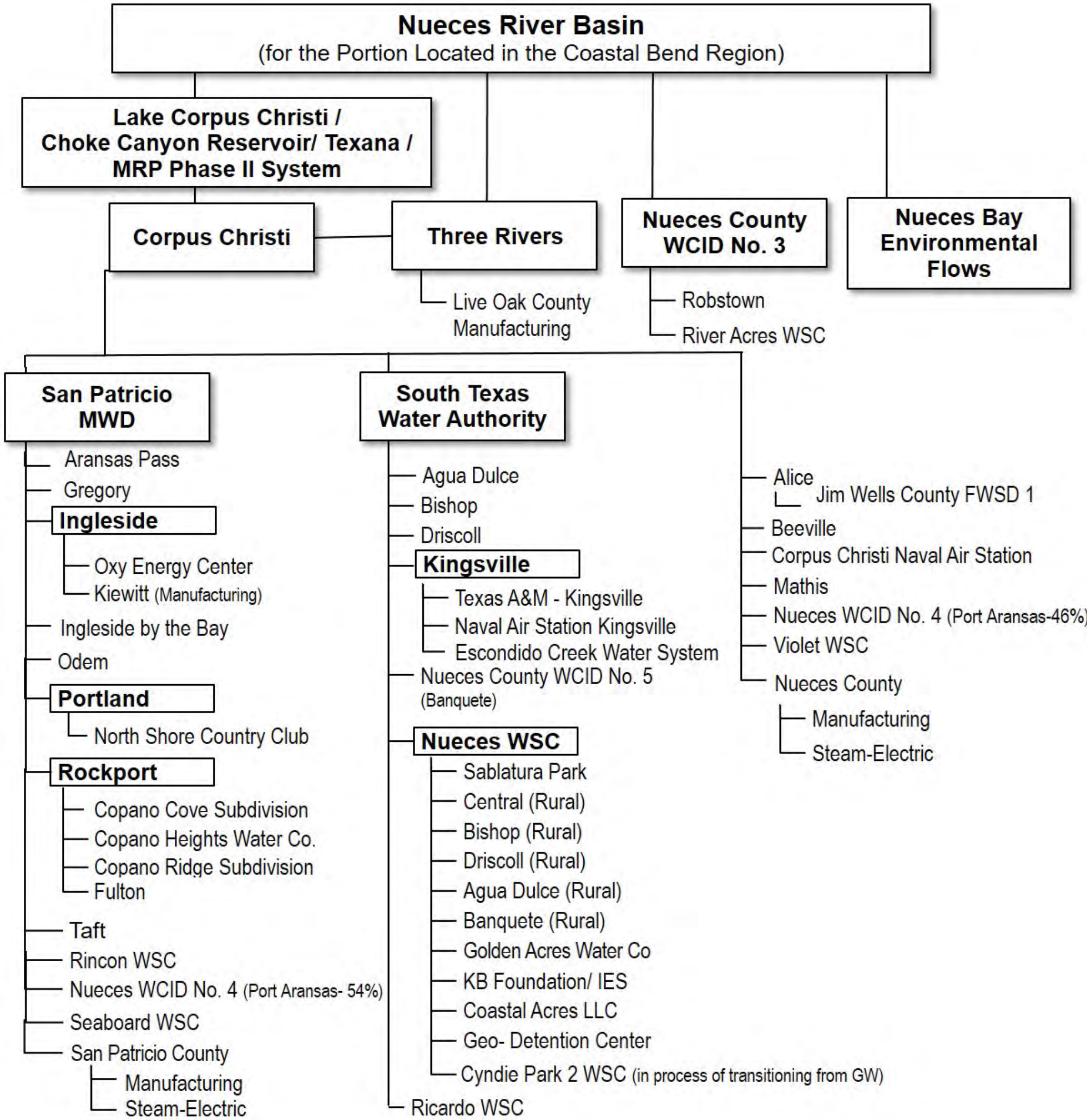

Figure 3.3.
Major Surface Water Supply Contract Relationships in the Coastal Bend Region

Figure 3.4 presents water supply systems in the Coastal Bend Region. These relationships will be revisited in Chapter 4A, when comparisons of supplies and demands in the region are presented.

3.1.7 Wholesale Water Providers

The Coastal Bend Region has four current Wholesale Water Providers. The TWDB defines Wholesale Water Providers as "any entity that delivers or sells water wholesale (treated or raw) to WUGs or other WWPs or that the RWPG expects or recommends to deliver or sell water wholesale to WUGs or other WWPs during the period covered by the plan." These include the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID #3. The City of Corpus Christi supplies about 52 percent of the water demand in the region (not including supplies to SPMWD or STWA). SPMWD and STWA purchase 100 percent of their water from the City of Corpus Christi. The SPMWD subsequently treats and distributes water to numerous entities and supplies about 10 percent of the municipal and industrial water demand in the region. Both STWA and Nueces County WCID #3 provide less than 3 percent of the municipal and industrial water demand in the region. Two potential future wholesale water providers were identified for recommended water management strategies, based on TWDB DB22 requirements: the PCCA and Poseidon Water. Both are associated with seawater desalination strategies to primarily serve future San Patricio County and Nueces County manufacturing users. The CBRWPG did not designate these two entities as WWPs.

As for water supply planning, each Water User Group in the region was analyzed to the same level of detail to ensure that the needs of the entire region are met. If in the future the CBRWPG deems it necessary, the CBRWPG reserves the right to revisit wholesale water provider designations during subsequent planning efforts.

3.1.8 Major Water Providers

The TWDB includes provisions in the regional water planning guidance for planning groups to consider identifying major water providers. The TWDB defines major water providers (MWPs) as "a water user group or wholesale water provider of particular significance to the region's water supply as determined by the regional water planning group, including public or private entities that provide water for any water use category." The CBRWPG considered this provision at the November 9, 2017 meeting. Four WWPs (City of Corpus Christi, SPMWD, STWA and Nueces County WCID 3) currently provide about 75% of the total water for Region N. For this reason, these WWPs are also considered MWPs. Existing supplies for the four current MWPs (i.e. WWPs) by decade and category of use is provided in Table 4A.24.

At the January 16, 2020 meeting, the CBRWPG approved inclusion of two seawater desalination water management strategy projects as recommended strategies that would be served by new water providers: Port of Corpus Christi Authority (PCCA) and Poseidon Water. Although these are not current MWPs, they are identified as potential future WWPs as discussed previously in Section 1.4.

3.2 Reliability of Surface Water Supply

Hydrologic conditions are a primary factor that affects the reliability of a water right. Severe drought periods have been experienced in all areas of the Coastal Bend Region. Recurring

Figure 3.4.
Coastal Bend Water Supply System

droughts are common in the region with significant drought periods occurring in the 1950s, 1960s, 1980s, 1990s, and current. As discussed previously in Chapter 1, average annual inflows to Lake Corpus Christi and Choke Canyon System continue to trend lower with each successive drought, with the most recent hydrology update[14] for the Corpus Christi Water Supply Model (through 2015) showing a *new* drought of record in the Nueces Basin from 2007 to 2013. Additional details regarding droughts in the region are discussed in Chapter 7.

Municipal and industrial water suppliers typically require a very high degree of reliability for their water sources. In most cases, interruptions to water supply are not acceptable, requiring the reliability of the supply to be 100 percent of the time. Municipal and industrial supplies are commonly based on firm yield; however, safe yield analyses are becoming commonly used in anticipation of future droughts greater in severity than the worst drought of record.

Based on the regional water supply system being prone to severe drought and a new drought of record defined from 2007 to 2013, on August, 10, 2017, the CBRWPG approved use of safe yield for users relying on supplies from the Corpus Christi Regional Water System. The safe yield maintains a 75,000 ac-ft reserve in storage during the worst, historical drought of record as a provision for climate and growth uncertainty, such that a *specified reserve amount remains* in storage during the modeled critical drought. On January 5, 2018, the TWDB granted approval for use of safe yield for the 2021 Coastal Bend Regional Water Plan.

For reservoirs, the safe yield may decrease over time as a result of sedimentation. When a reservoir is constructed on a stream channel, the sediment carried by the stream accumulates on the bottom of the reservoir. This accumulation reduces the volume of water that can be stored in the reservoir, which in turn reduces the firm yield available for diversion. Sedimentation rates for the CCR/LCC System were recently updated with new volumetric surveys.[15] The volumetric surveys for Choke Canyon Reservoir and Lake Corpus Christi reported sedimentation rates of 1,693 ac-ft/yr and 717 ac-ft/yr, respectively. Although this sedimentation rate is high, the Corpus Christi Water Supply System includes water supplies from Lake Texana and the Colorado River (MRP Phase II) that mitigate the effect of sedimentation accumulation in these two reservoirs on yield. Future reservoir capacity in 2070 was calculated based on sedimentation rates from the TWDB volumetric survey and extrapolating to 2070 conditions. It is estimated that the CCR/LCC/Texana/MRP Phase II system safe yield will be reduced by 11,000 ac-ft due to sediment accumulations between 2020 and 2070. The CCR/LCC/Texana/MRP Phase II system, during drought of record conditions, results in a safe yield supply of 178,000 ac-ft/yr in 2020 which reduces to 167,000 ac-ft/yr by 2070 due to reservoir sedimentation.

For Nueces County WCID 3 and smaller run-of-river water rights in the Nueces River Basin, firm yield supplies were based on the minimum annual supply that could be diverted over a historical

[14] Corpus Christi Water Supply Yield Results from Hydrology Update, June 1, 2017.
[15] Volumetric and Sedimentation Survey of Choke Canyon Reservoir June 2012 Survey. Texas Water Development Board, August 2013. (http://www.twdb.texas.gov/surfacewater/surveys/completed/files/ChokeCanyon/2012-06/ChokeCanyon2012_FinalReport.pdf), Volumetric and Sedimentation Survey of Lake Texana January – March 2010 Survey. Texas Water Development Board, August 2011. (http://www.twdb.texas.gov/surfacewater/surveys/completed/files/Texana/2010-03/Texana2010_FinalReport.pdf), *draft* Volumetric Survey and Sedimentation Survey of Lake Corpus Christi. Texas Water Development Board, 2016.

period of record limited by minimum month conditions in accordance with TWDB guidelines. Run-of-river availabilities were simulated for these water users using an unmodified Nueces WAM Run 3, which determined monthly availability subject to water right priority and hydrologic conditions. Minimum month conditions were assessed within the context of use-appropriate monthly percentage of the annual firm diversion. When the full amount sought was not available for a given month, storage was identified as a water management strategy to bridge potential seasonal water shortages to avoid overestimating the reliability of run-of-river water during drought.

3.3 Surface Water Availability

Two computer models were used to evaluate the water rights in the Nueces River Basin and within the Coastal Bend Region. The first model was a version of the Water Rights Analysis Package (WRAP) computer model developed by HDR Engineering, Inc. (HDR) for the TCEQ as part of its Water Availability Modeling (WAM) Program.[16] The WRAP model is designed for use as a water resources management tool. The model can be used to evaluate the reliability of existing water rights and to determine unappropriated streamflow potentially available for a new water right permit. WRAP simulates the management and use of streamflow and reservoirs over a historical period of record, adhering to the water right priority system. The second model used in determining surface water rights availability in the Nueces River Basin was the City of Corpus Christi Water Supply Model [formerly known as the Lower Nueces River Basin and Estuary Model (NUBAY)[17]]. The City of Corpus Christi Water Supply Model (CCWSM) focuses on the operations of the CCR/LCC/Lake Texana/MRP Phase II System and is capable of simulating this system subject to the City of Corpus Christi's Phased Operations Plan and the 2001 Agreed Order governing freshwater inflow passage to the Nueces Estuary.

In 2017, the Corpus Christi Water Supply Model was updated to include:

- Recent hydrology through 2015 to include the most recent drought of record for a total model period of 82 years (1934 to 2015), including extensions to net evaporation and ungaged runoff below LCC for recent hydrology using methods consistent with previous model version (1934 to 2003);
- New TWDB volumetric survey data for Lake Corpus Christi (2016), Choke Canyon Reservoir (2012), and Lake Texana (2010) for sedimentation rates;
- Recent hydrology for Lake Texana and the Colorado River (for Mary Rhodes Phase II supplies) through 2015; and

[16] HDR, "Water Availability in the Nueces River Basin," TCEQ, October 1999.
[17] In 1990, the City of Corpus Christi developed the Lower Nueces River Basin and Estuary Model (NUBAY) to evaluate its multi-basin regional water supply system subject to environmental flow provisions and reservoir operating policies. Since then, the City and other public agencies have supported enhancements and updates to the NUBAY model, which has been renamed the City of Corpus Christi Water Supply Model. The previous Region N Plans (2006, 2011, and 2016) used the Corpus Christi Water Supply Model to evaluate water availability, with safe yield as a basis for developing water planning and needs analysis for the City of Corpus Christi and its customers.

- Verification that all enhancements maintain the provisions of the TCEQ 2001 Agreed Order.

In 2019, additional model updates were made to include:

- Lake Texana callback of 10,400 ac-ft/yr as exercised by LNRA for local water users in Jackson County pursuant to City of Corpus Christi contract terms; and
- Operational flexibility to exercise water supply calls on the Garwood water right on the Colorado River at a variable rate according to diversion rate and priority date of the rights and based on MRP Phase II system capacities.

At the CBRWPG meeting on August 10, 2017, the planning group discussed TCEQ WAMs relevant to surface water supplies in the region and the CCWSM. The CBRWPG does not consider the TCEQ Nueces Basin WAM Run 3 to be the best model to simulate the Corpus Christi Regional Water Supply System operation policy subject to permits nor does it reflect all aspects of the TCEQ 2001 Agreed Order. Furthermore, the hydrology ends in 1996 and doesn't cover the recent drought of record. The CBRWPG submitted a variance request to the TWDB requesting use of the Corpus Christi Water Supply Model for determining surface water availability for the Corpus Christi Regional Water Supply System and approval to report water availability for the multi-basin regional supply as a system rather than individual reservoirs.

The CCWSM, authorized for use by the TWDB in January 2018, was used to estimate the safe yield of the CCR/LCC/Lake Texana/MRP Phase II System and the TCEQ WAM WRAP Model was used to determine the firm yield availability of water to all other rights on the Nueces River and its tributaries within the Coastal Bend Region. A summary of the water rights and yield availability is presented in Table 3.3. The surface water supplies are based on water rights and supply availability during the drought of record as discussed previously in Section 3.2.

Local supplies[18] are used in the plan to meet livestock needs only. The volume of local supply available to livestock users is based on the percent of surface water used to meet demands after considering 2010 groundwater use reported by the TWDB, discussed later in Section 4.2. Table 3.4 shows the amount of local supplies by decade for each livestock-county user, which totals 1,860 ac-ft/yr for the region. The livestock local surface water supplies presented in the table were identified based on 2010 use and considered firm supplies under drought conditions.

The surface water supplies described above serve as a basis for the supply and demand comparisons in Chapter 4A.

[18] The TWDB defines local supplies in Exhibit C- First Amended General Guidelines for Regional Water Plan Development (October 2012) as "limited, unnamed individual surface water supplies that, separately, are available only to particular non-municipal WUGs".

Table 3.3.
Surface Water Rights Availability
Nueces River Basin Water Rights in the Coastal Bend Region

Water Right Owner	Annual Permitted Diversion Volume (ac-ft/yr)	Yield[1] (ac-ft)	Type Of Use	Priority Date	County
City of Corpus Christi and Nueces River Authority	487,338[2]	167,000[3]	Municipal & Industrial	12/1913[4]	Nueces
			Irrigation	12/1913	Nueces
			Mining	12/1913	Nueces
			Irrigation	12/1913	Live Oak
Reality Traders & Exchange, Inc.	20	0	Irrigation	10/1952	San Patricio
Wayne Shambo	140	0	Irrigation	10/1952	San Patricio
Nueces Co. WCID #3	4,246 7,300 11,546	384	Municipal Irrigation	2/1909[4]	Nueces
Garnett T. & Patsy A. Brooks	221	0	Irrigation	2/1964	San Patricio
CE Coleman Estate	27	0	Irrigation	2/1964	Nueces
Ila M. Noakes Lindgreen	101	0	Irrigation	2/1964	Nueces
Randy J. Corporron, et al.	8	0	Irrigation	12/1965	McMullen
WL Flowers Machine & Welding Co.	132	6	Irrigation	12/1958	McMullen
Ted W. True, et al.	220	0	Irrigation	12/1958	McMullen
Harold W Nix, et ux.	0	0	Recreation	2/1969	McMullen
Richard P. Horton	336	0	Irrigation	12/1963	McMullen
James L. House Trust	123	0	Irrigation	12/1966	McMullen
City of Three Rivers	700 800 1,500	700 800 1,500	Municipal Industrial	9/1914	Live Oak
City of Taft	600	0	Irrigation	9/1983	San Patricio
Diamond Shamrock Refining	0[5]	0	Irrigation	6/1986	Live Oak
San Miguel Electric Co-Op, Inc.	300	0	Industrial	12/1990	McMullen
Muriell E. McNeill	64	0	Irrigation	9/1989	Live Oak
City of Mathis	50	0	Irrigation	11/1996	San Patricio
TOTAL	**513,126**	**168,884**			

[1] Yield computed assuming 2070 sediment accumulation in all reservoirs. City of Corpus Christi and Nueces River Authority is based on safe yield with all others based on firm yield. The City of Three Rivers owns 2% storage in Choke Canyon (see Table 3.1 for additional details), the yield of which is included in table calculations.

[2] Corpus Christi annual permitted diversion includes CCR/LCC System (443,898 ac-ft/yr) and LNRA contracts with Corpus Christi (31,440 ac-ft/yr) and a maximum 12,000 ac-ft/yr from Lake Texana on an interruptible basis.

[3] Corpus Christi minimum annual supply equals computed 2070 safe yield of the CCR/LCC/Lake Texana/MRP Phase II System per HDR water availability analysis for the City of Corpus Christi, April 2019.

[4] Water right with multiple priority dates. Earliest date shown in table.

[5] Diamond Shamrock irrigation right is for irrigation from on-site process water return flows. In effect, this permit is for a reuse project.

Table 3.4.
Livestock Local Surface Water Supplies (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Aransas	33	33	33	33	33	33
Bee	0	0	0	0	0	0
Brooks	125	125	125	125	125	125
Duval	2	2	2	2	2	2
Jim Wells	212	212	212	212	212	212
Kenedy	0	0	0	0	0	0
Kleberg	0	0	0	0	0	0
Live Oak	211	211	211	211	211	211
McMullen	279	279	279	279	279	279
Nueces	50	50	50	50	50	50
San Patricio	163	163	163	163	163	163
Total	**1,075**	**1,075**	**1,075**	**1,075**	**1,075**	**1,075**

Note: Supplies provided by stock ponds.

3.4 Reuse Availability

There are two counties in Region N that currently report reuse. Nueces County- manufacturing reports using 1,213 ac-ft/yr; and San Patricio County- manufacturing reports using 448 ac-ft/yr based on information provided by the TWDB.

3.5 Groundwater Availability

The Coastal Bend Region includes parts of five aquifers — two major (Gulf Coast and Carrizo-Wilcox Aquifers) and three minor (Yegua-Jackson, Queen City and Sparta Aquifers). Figure 3.1 shows the locations of the major and minor aquifers. According to TWDB guidelines, regional water planning groups are to use Modeled Available Groundwater (MAG) values developed by the Groundwater Management Areas (GMAs) and TWDB as groundwater supply availability estimates for the 2021 Regional Water Plan. All Region N counties are located within three Groundwater Management Areas as follows:

- GMA 13- McMullen County (portion),
- GMA 15- Aransas and Bee County (portion); and
- GMA 16- Remaining Region N counties.

All three of these GMAs adopted new desired future conditions (DFCs) between April 2016 and January 2017, as summarized in Table 3.5. These DFCs were then used by the TWDB to develop Modeled Available Groundwater estimates (MAGs) for use in development of the 2021 Coastal Bend Regional Water Plan. A summary of the MAGs is included in Table 3.6. These MAG projections based on GMA-approved desired future conditions were discussed at CBRWPG meeting on November 9, 2017 and confirmed to serve as the basis of groundwater availability in the 2021 Region N Plan. The CBRWPG did not perform any independent analyses using groundwater availability models (GAM) to estimate groundwater availability, nor were any alternative methods utilized to estimate groundwater availabilities.

Table 3.5.
Desired Future Conditions Adopted by GMAs in Region N

Aquifer	GMA	Desired Future Conditions (DFC)	Date DFC was Adopted
Carrizo-Wilcox, Queen City, and Sparta Aquifer	13	Average drawdown of 48 feet for all of GMA 13 calculated from the end of 2012 conditions to the year 2070	Nov 2016
Aransas Gulf Coast Aquifer	15	0 feet of drawdown of the Gulf Coast Aquifer System	Apr 2016
Bee Gulf Coast Aquifer	15	7 feet of drawdown of the Gulf Coast Aquifer System	Apr 2016
Bee GCD Gulf Coast Aquifer	16	76 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Live Oak UWCD Gulf Coast Aquifer	16	34 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
McMullen GCD Gulf Coast Aquifer	16	9 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Kenedy County GCD Gulf Coast Aquifer	16	40 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Brush Country GCD Gulf Coast Aquifer	16	69 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Duval County GCD Gulf Coast Aquifer	16	104 feet of drawdown of Gulf Coast Aquifer System	Jan 2017
San Patricio County GCD Gulf Coast Aquifer	16	48 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Non-District Kleberg Gulf Coast Aquifer	16	28 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017
Non-District Nueces Gulf Coast Aquifer	16	21 feet of drawdown of the Gulf Coast Aquifer System	Jan 2017

Of the five aquifers, the Gulf Coast Aquifer underlies all 11 counties in Region N, is the primary groundwater resource in the Coastal Bend Region, and is estimated to constitute 97 percent of the region's groundwater availability according to MAG. The Carrizo Wilcox underlies 3 counties and is estimated to constitute about 2 percent of the groundwater availability. The Queen City, Sparta, and Yegua- Jackson in McMullen County constitutes ~0.1 percent of the MAG.

3.5.1 Gulf Coast Aquifer

The Gulf Coast Aquifer underlies all counties within the Coastal Bend Region and yields mode-rate to large amounts of fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five water-bearing formations: Catahoula, Jasper, Burkeville Confining System, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water-bearing formations, are the most productive and, consequently, are the formations utilized most commonly. The Evangeline Aquifer of the Gulf Coast Aquifer System features the highly transmissive Goliad Sands. The Chicot Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Coastal Bend Area. The Burkeville Confining System is a limited water-bearing formation and characterized as containing substantial amounts of clay.

A Central Gulf Coast Groundwater Availability Model (CGCGAM) was developed by the TWDB to simulate steady-state, predevelopment and developed flow in the Gulf Coast Aquifer along the south Texas Gulf Coast and to assist in the determination of groundwater availability for the region; however, it had model limitations and was not considered to satisfactorily represent the Gulf Coast Aquifer in GMA 16, which covers the majority of the Coastal Bend Area. For this reason, the TWDB issued a Groundwater Management Area 16 Groundwater Flow Model for the Coastal Bend Region. This model was used to evaluate DFCs and set MAGs for the region, summarized in Table 3.6.

3.5.2 Carrizo-Wilcox Aquifer

Three counties within the Coastal Bend Region have Carrizo-Wilcox Aquifer reserves available to them. The Carrizo-Wilcox Aquifer contains moderate to large amounts of either fresh or slightly saline water. Slightly saline water is defined as water that contains 1,000 to 3,000 mg/L of dissolved solids. Although this aquifer reaches from the Rio Grande River north into Arkansas, it only underlies parts of McMullen, Live Oak, and Bee Counties within the Coastal Bend Region. Only McMullen County identified a MAG for the Carrizo Aquifer. Long-term groundwater available from the Carrizo-Wilcox in the region is summarized in Table 3.6.

3.5.3 Queen City and Sparta Aquifers

The Queen City and Sparta Aquifers are classified by the TWDB as minor aquifers and underlie McMullen County. The Queen City is a thick sand and sandy clay aquifer and runs from its southern boundary in Frio and LaSalle Counties northeasterly towards Louisiana. The Queen City Aquifer supplies small to moderate amounts of either fresh or slightly saline water in the Coastal Bend Region. The Sparta Aquifer is composed of interbedded sands and clays that yield small to moderate quantities with fresh to slightly saline quality.

3.5.4 Yegua- Jackson

The Yegua-Jackson Aquifer is classified by the TWDB as minor aquifer and underlies McMullen County. The Yegua- Jackson geologic unit consists of interbedded sand, silt, and clay layers. Most water is produced from the sand units, which water is either fresh or slightly saline. A MAG was not identified through the GCD/GMA process for the Yegua- Jackson Aquifer.

Table 3.6.
Groundwater Availability and Use from Aquifers within the Coastal Bend Region

County Name	Basin Name	Aquifer Name	TWDB Provided MAG for 2021 Region N Plan (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
Aransas	San Antonio-Nueces	Gulf Coast	1,542	1,542	1,542	1,542	1,542	1,542
Bee	Nueces	Carrizo	0	0	0	0	0	0
Bee	San Antonio-Nueces	Gulf Coast	17,640	18,917	19,526	19,776	19,951	19,951
Bee	Nueces	Gulf Coast	797	920	976	1,005	1,022	1,022
Brooks	Nueces-Rio Grande	Gulf Coast	5,582	6,352	7,122	7,892	7,892	7,892
Duval	Nueces	Gulf Coast	326	351	376	401	428	428
Duval	Nueces-Rio Grande	Gulf Coast	20,245	21,818	23,388	24,962	26,535	26,535
Jim Wells	Nueces	Gulf Coast	593	593	593	593	593	593
Jim Wells	Nueces-Rio Grande	Gulf Coast	8,551	9,090	9,593	10,132	10,424	10,424
Kenedy	Nueces-Rio Grande	Gulf Coast	13,301	18,621	23,941	29,261	29,261	29,261
Kleberg	Nueces-Rio Grande	Gulf Coast	10,365	13,082	15,800	18,518	18,711	18,711
Live Oak	San Antonio-Nueces	Gulf Coast	41	46	42	41	41	41
Live Oak	Nueces	Gulf Coast	8,297	9,297	8,522	8,400	8,400	8,400
Live Oak	Nueces	Carrizo	0	0	0	0	0	0
McMullen	Nueces	Carrizo	7,056	7,056	4,405	4,405	4,405	4,405
McMullen	Nueces	Gulf Coast	510	510	510	510	510	510
McMullen	Nueces	Queen City	134	134	134	134	134	134
McMullen	Nueces	Sparta	89	89	89	89	89	89
McMullen	Nueces	Yegua-Jackson	0	0	0	0	0	0
Nueces	San Antonio-Nueces	Gulf Coast	0	0	0	0	0	0
Nueces	Nueces	Gulf Coast	727	756	787	816	845	845
Nueces	Nueces-Rio Grande	Gulf Coast	5,862	6,191	6,522	6,851	7,079	7,079
San Patricio	San Antonio-Nueces	Gulf Coast	39,481	40,514	41,548	42,581	43,615	43,615
San Patricio	Nueces	Gulf Coast	4,130	4,502	4,874	5,247	5,619	5,619
Total Groundwater Availability (ac-ft/yr)			**145,269**	**160,381**	**170,290**	**183,156**	**187,096**	**187,096**
Gulf Coast Aquifer- MAG (ac-ft/yr)			***137,990***	***153,102***	***165,662***	***178,528***	***182,468***	***182,468***

3.6 Assigning Current Supplies to Water User Groups

Current water supplies were assigned to be consistent with TWDB and Texas Administrative Code guidance. Source water availability was limited according to minimum month drought of record conditions for surface water supplies and modeled available groundwater estimates for groundwater supplies. Additionally, legal and physical constraints were used to determine the amount available to water user groups and wholesale water providers. Water user groups that receive water from wholesale water providers or another water user group were limited according by contract, if applicable. Details of the water supply allocation methodology are included in Chapter 4A.2.

Current reuse information was obtained from the TWDB and by contacting wholesale water providers for consideration in development of the 2021 Plan. A discussion of current reuse amounts is included in Chapter 5D.5. Delineation of direct and indirect reuse was not provided.

4A

Identification of Water Needs

[31 TAC §357.33]

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Chapter 4A: Identification of Water Needs

4A.1 Introduction

In this chapter, the demand projections from Chapter 2 and the supply projections from Chapter 3 are brought together to estimate projected water needs in the Coastal Bend Region for the next 50 years. As a recap, Chapter 2 presented demand projections for six types of use: municipal, manufacturing, steam-electric, mining, irrigation, and livestock. Municipal water demand projections are shown for each utility as delineated by water provider service areas, rather than political boundaries. The municipal water user groups represent retail public utilities, privately-owned utilities, and state/federal owned water systems that provide more than 100 ac-ft/yr of water for municipal use. Smaller municipal systems are combined and reported for County-Other. Non-municipal water demand projections are shown on a county-wide basis for each county. Chapter 3 presented surface water availability by water right and groundwater availability and projected use by aquifer.

Chapter 4A.3 includes a summary page for each of the 11 counties in the Coastal Bend Region that highlights specific supply and demand information, followed by two tables. The first table contains supply and demand comparisons for the six types of water use; the second table contains supply and demand comparisons for the municipal water user groups in the county. Water supply and demand information aggregated for major water providers is summarized in Chapter 4A.4.

Chapter 4A.5 summarizes the secondary needs analysis, which estimates the water needs that would remain assuming full implementation of water conservation or direct reuse recommended water management strategies.

Chapter 4A.6 summarizes the water supply and demand picture for the entire region, focusing on those water user groups that have immediate and/or long-term needs.

A new provision in the Texas Water Code and Texas Administrative Code, effective June 28, 2020, in response to House Bill 807 requires RWPGs to define a threshold to determine whether it has significant water needs. In instances where a RWPG has determined there are significant identified water needs, the region shall include an assessment of the potential for aquifer storage and recovery to meet those water needs. The CBRWPG considered this statutory requirement during its September 3, 2020 meeting including the water customer relationships in the region. The CBRWPG considers significant water needs to be equal or greater than 20,000 ac-ft/yr. The Initially Prepared Region N Plan includes ASR as an evaluated strategy (Section 5D.7) and recommended WMS to meet future manufacturing needs in the Nueces County area as sponsored by the City of Corpus Christi.

4A.2 Allocation Methodology

Existing water supply was determined as the maximum amount of water available from existing sources during drought of record conditions, subject to physical transmission and/or treatment plant constraints and contract limits.

Surface water and groundwater availability was allocated among the six user groups using the methods explained below.

4A.2.1 Surface Water Allocation

Surface water in the region that is available to meet projected demands consists of the safe yield of the regional reservoir system, dependable supply of run-of-river water rights through drought of record conditions, and local on-farm sources. Surface water rights were allocated as supplies according to their stated type of use: municipal, industrial (manufacturing, steam-electric, and mining), and irrigation. Municipal supply was further allocated among cities and other municipal water supply entities. This was done by obtaining water seller information (i.e. which WWPs resell water to other water supply entities) and water purchase contract limits between buyers and sellers, provided by the TWDB and current WWPs. In most cases, for those cities purchasing water on a wholesale basis the contract amount remains constant through 2070. It was also assumed that water associated with a wholesaler that is not resold remains as an available supply to the wholesaler. In the case where a supply to a wholesaler is deficient to meet its own demands and contract requirements, a shortage would be expected for their non-municipal customers. Also in the case of surface water, the available supplies were compared to the water treatment plant (WTP) capacities shown in Table 4A.1.

Table 4A.1.
Water Treatment Plant Capacities for Region N Water User Groups

Entity	WTP Capacity (mgd)	Average Day WTP Capacity (mgd)	Average Day WTP Capacity (ac-ft/yr)
City of Beeville	6.4	5.2	5,833
City of Alice	8.7	6.7	7,560
City of Mathis	2.2	1.7	1,877
City of Three Rivers	3.0	2.1	2,399
Nueces County WCID #3	6.6	5.0	5,605
City of Corpus Christi	160	114.3	128,114
San Patricio Municipal Water District*	34.8	24.6	27,529

*Note: Includes municipal (potable) average day capacity of 12.9 mgd (14,457 ac-ft/yr) and industrial treatment plant average day capacity of 11.7 mgd (13,072 ac-ft/yr).

If the total available surface water supplies were greater than treatment plant capacity, the supplies were constrained by the treatment plant capacity. A detailed explanation of water demand and supplies for current WWPs[1] is described in Chapter 4.4. Figure 4A.1 shows how surface water in the Coastal Bend Region is distributed.

Two situations deserve special attention regarding raw water supplies for the region. The City of Corpus Christi (City) has 178,000 ac-ft/yr in available safe yield supply in 2020, through its own water right in the Nueces Basin from the CCR/LCC System, a contract with the Lavaca-Navidad River Authority for a base amount of 31,440 ac-ft/yr[2] and up to 12,000 ac-ft on an interruptible basis from Lake Texana, and up to 35,000 ac-ft/yr from the City's Garwood water rights. These supplies are referred to collectively as supplies from the CCR/LCC/Texana/MRP Phase II System (or Corpus Christi Regional Water Supply System).

From this supply, the City of Corpus Christi provides water to its municipal customers throughout Region N and manufacturing and steam-electric customers in Nueces County (Figure 3.3). San Patricio Municipal Water District (SPMWD) has a contract to buy up to 73,800 ac-ft of raw and treated water from the City of Corpus Christi and provides water to municipal customers in Aransas, Nueces and San Patricio Counties, as well as manufacturing customers in San Patricio County. South Texas Water Authority (STWA) supplies municipal and rural customers in Nueces and Kleberg Counties. Nueces County WCID #3 supplies the City of Robstown and River Acres WSC in Nueces County.

[1] The Port of Corpus Christi Authority (PCCA) and Poseidon Water are potential future WWPs for recommended water management based on TWDB DB22 requirements. However, water supply plans are not included for them since they are not current WWPs and were not identified as WWPs by the CBRWPG.
[2] Accounts for LNRA call-back of 10,400 ac-ft/yr for Jackson County uses per contract.

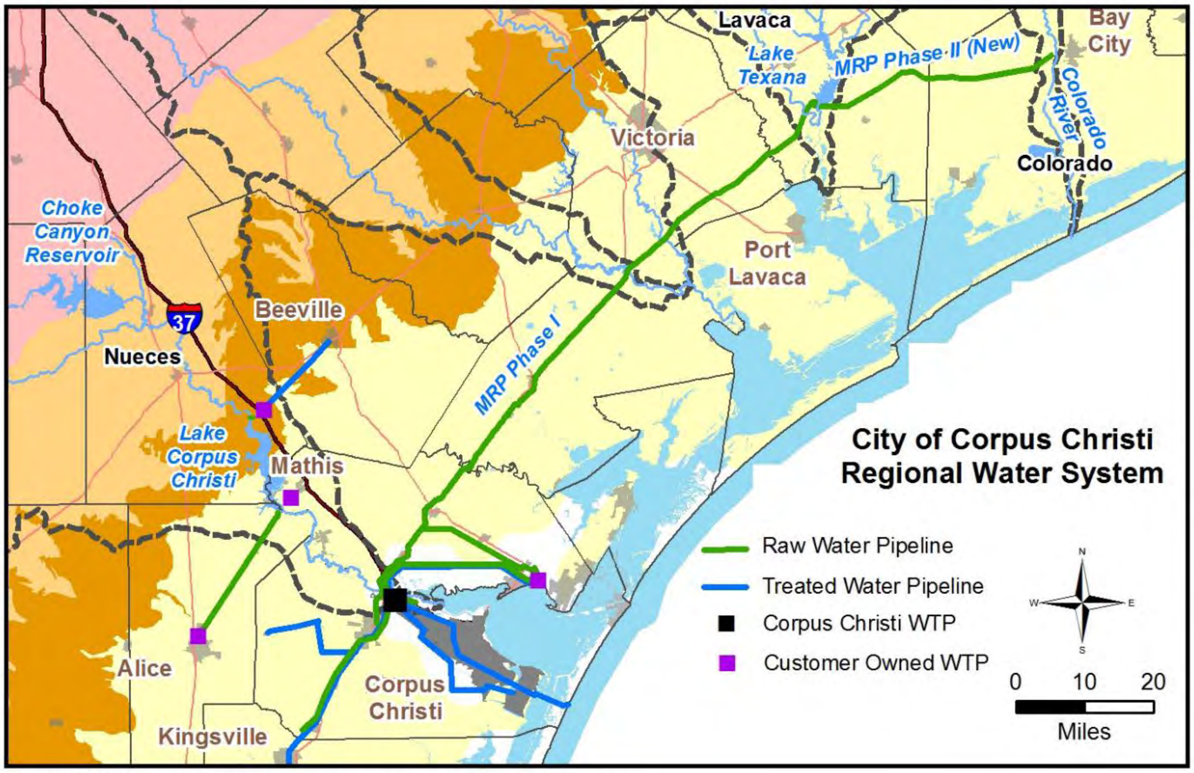


Figure 4A.1.
Distribution of Surface Water from the Corpus Christi Regional Water System in the Coastal Bend Region

The final process in the allocation of surface water supplies was to examine the available WTP capacity for each entity with a WTP and compare that capacity to existing raw water supplies. The WTP capacity was calculated based on average day production using a peaking factor based on recent water use records and feedback from the utility. If the WTP capacity was insufficient to treat the existing raw water supplies, then surface water supplies to that entity were limited to the current WTP treatment capacity. Current WTP capacities are shown in Table 4A.1.

Local surface water supply from stock ponds is available to meet livestock needs when groundwater supplies are insufficient to meet those demands. Generally, these ponds (less than 200 ac-ft of storage) are not large enough to require a water rights permit.

4A.2.2 Groundwater Allocation

Groundwater is regulated locally by groundwater conservation districts except in locations that do not have a district. Districts may issue permits that regulate pumping of groundwater and spacing of wells within their jurisdictions. Multiple districts within a single Groundwater Management Area (GMA) determine the desired future conditions of relevant aquifers within that area. Three GMA's are represented within the Region N 11-county area: GMA 13, GMA 15, and GMA 16. All three of these GMAs adopted new desired future conditions (DFCs) between April 2016 and January 2017 as described in Chapter 3. These DFCs were then used by the TWDB to develop Modeled Available Groundwater (MAGs) volumes. A MAG volume is the amount of groundwater production, on an average annual basis, that will achieve a DFC. The DFC at a specific location may not be achieved if groundwater production exceeds the MAG volume over the long term. These MAG projections based on GMA-approved desired future conditions were adopted on November 9, 2017 by the Coastal Bend Regional Water Planning Group as the basis of groundwater availability in the 2021 Region N Plan.

Current groundwater supplies in the 2021 Region N Water Plan are based on MAG projections provided by the TWDB, constrained by well capacity as reported in the TCEQ Public Water System (PWS) database. For non-municipal groundwater users with groundwater capacities that are not readily obtained from publicly available sources, the groundwater supply was calculated based on TWDB historical water use records. The final step in determining groundwater supplies was to compare the MAG-preserved well capacities to projected demands for each WUG that has historically relied on groundwater. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower.

For WUGs that use both groundwater and surface water supplies, it was generally assumed that the water user group would use groundwater up to its well capacity (limited by MAG) and then use available surface water per rights or contracts to total the projected water demand through combination of groundwater and surface water supplies. It is assumed that groundwater beyond demands would not be pumped and therefore would be available as a collective resource for future water management strategy development subject to adopted MAGs.

Total anticipated groundwater production in any planning decade may not exceed the MAG volume in any county-aquifer location (total groundwater production includes quantities associated with both existing supplies and any recommended water management strategies). This prevents regional water planning groups from recommending water management strategies with supply volumes that would result in exceeding (i.e. “overdrafting”) approved MAG volumes. Groundwater supply was generally allocated in the following manner:

Municipal Use

- For cities, groundwater supply was based upon projected water use or well capacity reported to TCEQ, whichever is less.
- For rural areas, well capacities were estimated as the highest groundwater usage from 2010-2015.

Irrigation Use

- Irrigation supply was estimated as either the projected demand in each decade or well capacity, whichever is less. The well capacity was estimated as the maximum amount of water used by irrigators in 2010 to 2015 according to self-reported survey to the TWDB. Actual well capacity pumping constraints may be different than those estimated based on previous maximum annual irrigation water use. Most irrigation water in the

Coastal Bend Region is applied during growing seasons, and therefore wells may be capable of providing additional supplies for peak use conditions.

Manufacturing Use

- The manufacturing well capacity was generally estimated as the highest groundwater usage from 2010-2015. Groundwater supply was based on projected water use or estimated well capacities, whichever is less.

Mining Use

- The mining supply was estimated as either the projected demand in each decade or well capacity, whichever is less. Well capacity was generally estimated as the highest groundwater usage from 2010-2015.

Livestock Use

- The groundwater supply for livestock was calculated based on maximum historic groundwater use reported by TWDB from 2010 to 2015. Any remaining demand is met with local surface water supplies.

4A.3 County Summaries – Comparison of Demand to Supply

4A.3.1 Comparison of Demand to Supply – Aransas County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.2 for all categories of water use. Table 4A.3 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand decreases from 4,085 ac-ft in 2020 to 3,987 ac-ft in 2050 and to 3,979 ac-ft in 2070.
- There are no manufacturing or stream-electric demands projected; mining demand decreases from 10 to 5 ac-ft from 2020 to 2070.
- There is no irrigation demand projected; livestock demand is constant at 56 ac-ft/yr.

Supplies

- Surface water from the CCR/LCC/Texana/MRP Phase II System is supplied to municipalities via the SPMWD.
- Groundwater supplies are from the Gulf Coast Aquifer.
- Surface water for livestock needs is provided from on-farm and local sources.

Comparison of Demand to Supply

- There are adequate supplies available to meet all projected demands through the planning period.

Table 4A.2. Aransas County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		24,463	24,991	24,937	25,102	25,103	25,104
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand (See Table 4A.3)	4,085	4,080	3,999	3,987	3,979	3,979
	Municipal Existing Supply						
	Groundwater	371	362	349	345	343	343
	Surface water	3,714	3,718	3,650	3,642	3,636	3,636
	Total Existing Municipal Supply	4,085	4,080	3,999	3,987	3,979	3,979
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	0	0	0	0	0	0
	Manufacturing Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	10	7	5	5	5	5
	Mining Existing Supply						
	Groundwater	10	7	5	5	5	5
	Surface water	0	0	0	0	0	0
	Total Mining Supply	10	7	5	5	5	5
	Mining Balance	0	0	0	0	0	0
Agriculture	Irrigation Demand	0	0	0	0	0	0
	Irrigation Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	0	0	0	0	0	0
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	56	56	56	56	56	56
	Livestock Existing Supply						
	Groundwater	23	23	23	23	23	23
	Surface water	33	33	33	33	33	33
	Total Livestock Supply	56	56	56	56	56	56
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	4,095	4,087	4,004	3,992	3,984	3,984
	Existing Municipal and Industrial Supply						
	Groundwater	381	369	354	350	348	348
	Surface water	3,714	3,718	3,650	3,642	3,636	3,636
	Total Municipal and Industrial Supply	4,095	4,087	4,004	3,992	3,984	3,984
	Municipal and Industrial Balance	0	0	0	0	0	0
	Agriculture Demand	56	56	56	56	56	56
	Existing Agricultural Supply						
	Groundwater	23	23	23	23	23	23
	Surface water	33	33	33	33	33	33
	Total Agriculture Supply	56	56	56	56	56	56
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	4,151	4,143	4,060	4,048	4,040	4,040
	Total Supply						
	Groundwater	404	392	377	373	371	371
	Surface water	3,747	3,751	3,683	3,675	3,669	3,669
	Total Supply	4,151	4,143	4,060	4,048	4,040	4,040
	Total Balance	0	0	0	0	0	0

Table 4A.3.
Aransas County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Aransas Pass						
Demand	132	131	127	126	126	126
Supply	132	131	127	126	126	126
Groundwater	-	-	-	-	-	-
Surface Water	132	131	127	126	126	126
Balance	-	-	-	-	-	-
Rockport						
Demand	3,462	3,469	3,410	3,404	3,398	3,398
Supply	3,462	3,469	3,410	3,404	3,398	3,398
Groundwater	-	-	-	-	-	-
Surface Water	3,462	3,469	3,410	3,404	3,398	3,398
Balance	-	-	-	-	-	-
County-Other						
Demand	491	480	462	457	455	455
Supply	491	480	462	457	455	455
Groundwater	371	362	349	345	343	343
Surface Water	120	118	113	112	112	112
Balance	-	-	-	-	-	-
County Total						
Demand	4,085	4,080	3,999	3,987	3,979	3,979
Supply	4,085	4,080	3,999	3,987	3,979	3,979
Groundwater	371	362	349	345	343	343
Surface Water	3,714	3,718	3,650	3,642	3,636	3,636
Balance	-	-	-	-	-	-

4A.3.2 Comparison of Demand to Supply – Bee County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.4 for all categories of water use. Table 4A.5 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 6,439 ac-ft in 2020 to 6,553 ac-ft in 2030, then decreases to 6,497 ac-ft in 2070.
- There are no manufacturing or stream-electric demands from 2020 to 2070.
- Mining demand decreases from 472 ac-ft in 2020 to 318 ac-ft in 2070.
- For the period 2020 to 2070, irrigation demand is constant at 4,425 ac-ft; livestock demand is constant at 834 ac-ft.

Supplies

- Surface water is provided to the City of Beeville from Lake Corpus Christi associated with the CCR/LCC/Texana/MRP Phase II System. The City of Beeville has groundwater supplies that they use in conjunction with surface water.
- Groundwater supplies are from the Gulf Coast Aquifer and limited by water well capacity which was estimated based on TWDB historical water use records from 2010-2015. There is sufficient MAG available.
- Groundwater supply for irrigation was set equal to the maximum historical pumpage (i.e. estimated well capacity).

Comparison of Demand to Supply

- There are insufficient supplies available to meet projected demands. In 2020 Bee County has a projected water shortage of 2,477 ac-ft, and decreases to a shortage of 2,361 ac-ft in 2070.

Table 4A.4. Bee County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		33,478	34,879	35,487	35,545	35,579	35,590
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand (See Table 4A.5)	6,439	6,553	6,547	6,506	6,496	6,497
	Municipal Existing Supply						
	Groundwater	2,586	2,588	2,587	2,586	2,585	2,585
	Surface water	1,925	1,986	1,983	1,966	1,964	1,965
	Total Existing Municipal Supply	4,511	4,574	4,570	4,552	4,549	4,550
	Municipal Balance	(1,928)	(1,979)	(1,977)	(1,954)	(1,947)	(1,947)
Industrial	Manufacturing Demand	0	0	0	0	0	0
	Manufacturing Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	472	458	428	372	338	318
	Mining Existing Supply						
	Groundwater	275	273	270	263	259	256
	Surface water	0	0	0	0	0	0
	Total Mining Supply	275	273	270	263	259	256
	Mining Balance	(197)	(185)	(158)	(109)	(79)	(62)
Agriculture	Irrigation Demand	4,425	4,425	4,425	4,425	4,425	4,425
	Irrigation Existing Supply						
	Groundwater	4,073	4,073	4,073	4,073	4,073	4,073
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	4,073	4,073	4,073	4,073	4,073	4,073
	Irrigation Balance	(352)	(352)	(352)	(352)	(352)	(352)
	Livestock Demand	834	834	834	834	834	834
	Livestock Existing Supply						
	Groundwater	834	834	834	834	834	834
	Surface water	0	0	0	0	0	0
	Total Livestock Supply	834	834	834	834	834	834
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	6,911	7,011	6,975	6,878	6,834	6,815
	Existing Municipal and Industrial Supply						
	Groundwater	2,861	2,861	2,857	2,849	2,844	2,841
	Surface water	1,925	1,986	1,983	1,966	1,964	1,965
	Total Municipal and Industrial Supply	4,786	4,847	4,840	4,815	4,808	4,806
	Municipal and Industrial Balance	(2,125)	(2,164)	(2,135)	(2,063)	(2,026)	(2,009)
	Agriculture Demand	5,259	5,259	5,259	5,259	5,259	5,259
	Existing Agricultural Supply						
	Groundwater	4,907	4,907	4,907	4,907	4,907	4,907
	Surface water	0	0	0	0	0	0
	Total Agriculture Supply	4,907	4,907	4,907	4,907	4,907	4,907
	Agriculture Balance	(352)	(352)	(352)	(352)	(352)	(352)
	Total Demand	12,170	12,270	12,234	12,137	12,093	12,074
	Total Supply						
	Groundwater	7,768	7,768	7,764	7,756	7,751	7,748
	Surface water	1,925	1,986	1,983	1,966	1,964	1,965
	Total Supply	9,693	9,754	9,747	9,722	9,715	9,713
	Total Balance	(2,477)	(2,516)	(2,487)	(2,415)	(2,378)	(2,361)

Table 4A.5.
Bee County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Beeville						
Demand	3,336	3,397	3,394	3,377	3,375	3,376
Supply	3,336	3,397	3,394	3,377	3,375	3,376
Groundwater	1,411	1,411	1,411	1,411	1,411	1,411
Surface Water	1,925	1,986	1,983	1,966	1,964	1,965
Balance	-	-	-	-	-	-
El Oso WSC						
Demand	100	101	101	101	96	96
Supply	6	7	7	7	6	6
Groundwater	6	7	7	7	6	6
Surface Water	-	-	-	-	-	-
Balance	(94)	(94)	(94)	(94)	(90)	(90)
Pettus MUD						
Demand	104	105	104	103	103	103
Supply	104	105	104	103	103	103
Groundwater	104	105	104	103	103	103
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
TDCJ Chase Field						
Demand	1,024	1,050	1,055	1,051	1,050	1,050
Supply	847	847	847	847	847	847
Groundwater	847	847	847	847	847	847
Surface Water	-	-	-	-	-	-
Balance	(177)	(203)	(208)	(204)	(203)	(203)
County-Other						
Demand	1,875	1,900	1,893	1,874	1,872	1,872
Supply	218	218	218	218	218	218
Groundwater	218	218	218	218	218	218
Surface Water	-	-	-	-	-	-
Balance	(1,657)	(1,682)	(1,675)	(1,656)	(1,654)	(1,654)
County Total						
Demand	6,439	6,553	6,547	6,506	6,496	6,497
Supply	4,511	4,574	4,570	4,552	4,549	4,550
Groundwater	2,586	2,588	2,587	2,586	2,585	2,585
Surface Water	1,925	1,986	1,983	1,966	1,964	1,965
Balance	(1,928)	(1,979)	(1,977)	(1,954)	(1,947)	(1,947)

4A.3.3 Comparison of Demand to Supply – Brooks County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.6 for all categories of water use. Table 4A.7 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 1,863 ac-ft in 2020 to 2,042 ac-ft in 2050 and to 2,193 ac-ft in 2070.
- Mining demand decreases from 357 ac-ft to 298 ac-ft from 2020 to 2070.
- For the period 2020 to 2070, irrigation demand is constant at 1,161 ac-ft; livestock demand is constant at 463 ac-ft.

Supplies

- Surface water for livestock needs is provided from on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- There are insufficient supplies to meet municipal and industrial demands through 2070.

Table 4A.6. Brooks County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		7,783	8,252	8,722	9,181	9,595	9,979
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand (See Table 4A.7)	1,863	1,914	1,972	2,042	2,114	2,193
	Municipal Existing Supply						
	Groundwater	1,671	1,700	1,735	1,777	1,822	1,884
	Surface water	0	0	0	0	0	0
	Total Existing Municipal Supply	1,671	1,700	1,735	1,777	1,822	1,884
	Municipal Balance	(192)	(214)	(237)	(265)	(292)	(309)
Industrial	Manufacturing Demand	1	1	1	1	1	1
	Manufacturing Existing Supply						
	Groundwater	1	1	1	1	1	1
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	1	1	1	1	1	1
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	357	360	340	324	308	298
	Mining Existing Supply						
	Groundwater	178	178	178	178	178	178
	Surface water	0	0	0	0	0	0
	Total Mining Supply	178	178	178	178	178	178
	Mining Balance	(179)	(182)	(162)	(146)	(130)	(120)
Agriculture	Irrigation Demand	1,161	1,161	1,161	1,161	1,161	1,161
	Irrigation Existing Supply						
	Groundwater	1,161	1,161	1,161	1,161	1,161	1,161
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	1,161	1,161	1,161	1,161	1,161	1,161
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	463	463	463	463	463	463
	Livestock Existing Supply						
	Groundwater	338	338	338	338	338	338
	Surface water	125	125	125	125	125	125
	Total Livestock Supply	463	463	463	463	463	463
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	2,221	2,275	2,313	2,367	2,423	2,492
	Existing Municipal and Industrial Supply						
	Groundwater	1,850	1,879	1,914	1,956	2,001	2,063
	Surface water	0	0	0	0	0	0
	Total Municipal and Industrial Supply	1,850	1,879	1,914	1,956	2,001	2,063
	Municipal and Industrial Balance	(371)	(396)	(399)	(411)	(422)	(429)
	Agriculture Demand	1,624	1,624	1,624	1,624	1,624	1,624
	Existing Agricultural Supply						
	Groundwater	1,499	1,499	1,499	1,499	1,499	1,499
	Surface water	125	125	125	125	125	125
	Total Agriculture Supply	1,624	1,624	1,624	1,624	1,624	1,624
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	3,845	3,899	3,937	3,991	4,047	4,116
	Total Supply						
	Groundwater	3,349	3,378	3,413	3,455	3,500	3,562
	Surface water	125	125	125	125	125	125
	Total Supply	3,474	3,503	3,538	3,580	3,625	3,687
	Total Balance	(371)	(396)	(399)	(411)	(422)	(429)

Table 4A.7. Brooks County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Falfurrias						
Demand	1,639	1,668	1,703	1,745	1,790	1,852
Supply	1,639	1,668	1,703	1,745	1,790	1,852
Groundwater	1,639	1,668	1,703	1,745	1,790	1,852
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County-Other						
Demand	224	246	269	297	324	341
Supply	32	32	32	32	32	32
Groundwater	32	32	32	32	32	32
Surface Water	-	-	-	-	-	-
Balance	(192)	(214)	(237)	(265)	(292)	(309)
County Total						
Demand	1,863	1,914	1,972	2,042	2,114	2,193
Supply	1,671	1,700	1,735	1,777	1,822	1,884
Groundwater	1,671	1,700	1,735	1,777	1,822	1,884
Surface Water	-	-	-	-	-	-
Balance	(192)	(214)	(237)	(265)	(292)	(309)

4A.3.4 Comparison of Demand to Supply – Duval County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.8 for all categories of water use. Table 4A.9 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 2,171 ac-ft in 2020 to 2,353 ac-ft in 2050 then to 2,477 ac-ft in 2070.
- Mining demand decreases from 1,388 ac-ft in 2020, to 1,241 ac-ft in 2050, to 1,104 ac-ft in 2070.
- For the period 2020 to 2070, irrigation demand remains constant at 4,042 ac-ft; livestock demand is constant at 640 ac-ft.

Supplies

- Surface water for livestock needs is provided from on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- Due to water well capacity limitations, the City of San Diego is projected to have a water shortage of 288 ac-ft/yr in 2020, increasing to 417 ac-ft/yr in 2070. County-other is also projected to have a shortage of 477 ac-ft/yr in 2020 that grows to 516 ac-ft/yr in 2070. Mining has a projected shortage of 712 ac-ft/yr in 2030, decreasing to a shortage of 428 ac-ft/yr in 2070.

Table 4A.8.
Duval County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		12,715	13,470	14,098	14,644	15,080	15,435
	Supply and Demand by Type of Use	**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.9)	2,171	2,236	2,291	2,353	2,420	2,477
	Municipal Existing Supply						
	Groundwater	1,406	1,437	1,463	1,491	1,520	1,544
	Surface water	0	0	0	0	0	0
	Total Existing Municipal Supply	1,406	1,437	1,463	1,491	1,520	1,544
	Municipal Balance	(765)	(799)	(828)	(862)	(900)	(933)
Industrial	Manufacturing Demand	0	0	0	0	0	0
	Manufacturing Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	1,388	1,444	1,352	1,241	1,165	1,104
	Mining Existing Supply						
	Groundwater	676	676	676	676	676	676
	Surface water	0	0	0	0	0	0
	Total Mining Supply	676	676	676	676	676	676
	Mining Balance	(712)	(768)	(676)	(565)	(489)	(428)
Agriculture	Irrigation Demand	4,042	4,042	4,042	4,042	4,042	4,042
	Irrigation Existing Supply						
	Groundwater	4,042	4,042	4,042	4,042	4,042	4,042
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	4,042	4,042	4,042	4,042	4,042	4,042
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	640	640	640	640	640	640
	Livestock Existing Supply						
	Groundwater	638	638	638	638	638	638
	Surface water	2	2	2	2	2	2
	Total Livestock Supply	640	640	640	640	640	640
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	3,559	3,680	3,643	3,594	3,585	3,581
	Existing Municipal and Industrial Supply						
	Groundwater	2,082	2,113	2,139	2,167	2,196	2,220
	Surface water	0	0	0	0	0	0
	Total Municipal and Industrial Supply	2,082	2,113	2,139	2,167	2,196	2,220
	Municipal and Industrial Balance	(1,477)	(1,567)	(1,504)	(1,427)	(1,389)	(1,361)
	Agriculture Demand	4,682	4,682	4,682	4,682	4,682	4,682
	Existing Agricultural Supply						
	Groundwater	4,680	4,680	4,680	4,680	4,680	4,680
	Surface water	2	2	2	2	2	2
	Total Agriculture Supply	4,682	4,682	4,682	4,682	4,682	4,682
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	8,241	8,362	8,325	8,276	8,267	8,263
	Total Supply						
	Groundwater	6,762	6,793	6,819	6,847	6,876	6,900
	Surface water	2	2	2	2	2	2
	Total Supply	6,764	6,795	6,821	6,849	6,878	6,902
	Total Balance	(1,477)	(1,567)	(1,504)	(1,427)	(1,389)	(1,361)

Table 4A.9. Duval County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Duval County CRD						
Demand	260	266	271	277	285	291
Supply	260	266	271	277	285	291
Groundwater	260	266	271	277	285	291
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Freer WCID						
Demand	687	712	733	755	776	794
Supply	687	712	733	755	776	794
Groundwater	687	712	733	755	776	794
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
San Diego MUD						
Demand	747	774	797	824	851	876
Supply	459	459	459	459	459	459
Groundwater	459	459	459	459	459	459
Surface Water	-	-	-	-	-	-
Balance	(288)	(315)	(338)	(365)	(392)	(417)
County-Other						
Demand	477	484	490	497	508	516
Supply	-	-	-	-	-	-
Groundwater	-	-	-	-	-	-
Surface Water	-	-	-	-	-	-
Balance	(477)	(484)	(490)	(497)	(508)	(516)
County Total						
Demand	2,171	2,236	2,291	2,353	2,420	2,477
Supply	1,406	1,437	1,463	1,491	1,520	1,544
Groundwater	1,406	1,437	1,463	1,491	1,520	1,544
Surface Water	-	-	-	-	-	-
Balance	(765)	(799)	(828)	(862)	(900)	(933)

4A.3.5 Comparison of Demand to Supply – Jim Wells County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.10 for all categories of water use. Table 4A.11 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 8,079 ac-ft in 2020 to 9,459 ac-ft in 2050, then to 10,434 ac-ft in 2070.
- Mining demand decreases from 71 ac-ft in 2020 to 17 ac-ft in 2070.
- For the period 2020 to 2070, irrigation demand remains constant at 1,913 ac-ft; livestock demand is constant at 902 ac-ft.

Supplies

- Surface water is provided to the City of Alice from the CCR/LCC/Texana/MRP Phase II System; livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer. San Diego groundwater supply is obtained from Duval County CRD.

Comparison of Demand to Supply

- There are sufficient municipal supplies available through 2070 for Alice, Orange Grove, Premont, San Diego MUD 1, and Jim Wells County FWSD 1.
- Due to water well capacity limitations, the county-other user group is projected to have a water shortage of 2,058 ac-ft/yr in 2020, increasing to 2,650 ac-ft/yr in 2070.
- Manufacturing has a projected water shortage of 16 ac-ft/yr beginning in 2030 and maintained through 2070.
- Mining has a projected shortage of 52 ac-ft/yr in 2020 that decreases to 1 ac-ft/yr in 2070.
- Irrigation shows a projected water shortage that remains constant at 333 ac-ft/yr throughout the planning period.
- There are sufficient agricultural supplies to meet livestock demand through 2070.

Table 4A.10.
Jim Wells County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		44,987	48,690	52,052	55,533	58,600	61,410
	Supply and Demand by Type of Use	**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.11)	8,079	8,524	8,943	9,459	9,960	10,434
	Municipal Existing Supply						
	Groundwater	1,527	1,616	1,699	1,797	1,887	1,972
	Surface water	4,494	4,744	4,978	5,267	5,548	5,812
	Total Existing Municipal Supply	6,021	6,360	6,677	7,064	7,435	7,784
	Municipal Balance	(2,058)	(2,164)	(2,266)	(2,395)	(2,525)	(2,650)
Industrial	Manufacturing Demand	79	95	95	95	95	95
	Manufacturing Existing Supply						
	Groundwater	79	79	79	79	79	79
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	79	79	79	79	79	79
	Manufacturing Balance	0	(16)	(16)	(16)	(16)	(16)
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	71	74	55	40	26	17
	Mining Existing Supply						
	Groundwater	19	19	19	19	19	16
	Surface water	0	0	0	0	0	0
	Total Mining Supply	19	19	19	19	19	16
	Mining Balance	(52)	(55)	(36)	(21)	(7)	(1)
Agriculture	Irrigation Demand	1,913	1,913	1,913	1,913	1,913	1,913
	Irrigation Existing Supply						
	Groundwater	1,580	1,580	1,580	1,580	1,580	1,580
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	1,580	1,580	1,580	1,580	1,580	1,580
	Irrigation Balance	(333)	(333)	(333)	(333)	(333)	(333)
	Livestock Demand	902	902	902	902	902	902
	Livestock Existing Supply						
	Groundwater	690	690	690	690	690	690
	Surface water	212	212	212	212	212	212
	Total Livestock Supply	902	902	902	902	902	902
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	8,229	8,693	9,093	9,594	10,081	10,546
	Existing Municipal and Industrial Supply						
	Groundwater	1,625	1,714	1,797	1,895	1,985	2,067
	Surface water	4,494	4,744	4,978	5,267	5,548	5,812
	Total Municipal and Industrial Supply	6,119	6,458	6,775	7,162	7,533	7,879
	Municipal and Industrial Balance	(2,110)	(2,235)	(2,318)	(2,432)	(2,548)	(2,667)
	Agriculture Demand	2,815	2,815	2,815	2,815	2,815	2,815
	Existing Agricultural Supply						
	Groundwater	2,270	2,270	2,270	2,270	2,270	2,270
	Surface water	212	212	212	212	212	212
	Total Agriculture Supply	2,482	2,482	2,482	2,482	2,482	2,482
	Agriculture Balance	(333)	(333)	(333)	(333)	(333)	(333)
	Total Demand	11,044	11,508	11,908	12,409	12,896	13,361
	Total Supply						
	Groundwater	3,895	3,984	4,067	4,165	4,255	4,337
	Surface water	4,706	4,956	5,190	5,479	5,760	6,024
	Total Supply	8,601	8,940	9,257	9,644	10,015	10,361
	Total Balance	(2,443)	(2,568)	(2,651)	(2,765)	(2,881)	(3,000)

Table 4A.11.
Jim Wells County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Alice						
Demand	4,494	4,744	4,978	5,267	5,548	5,812
Supply	4,494	4,744	4,978	5,267	5,548	5,812
Groundwater	-	-	-	-	-	-
Surface Water	4,494	4,744	4,978	5,267	5,548	5,812
Balance	-	-	-	-	-	-
Jim Wells County FWSD						
Demand	131	141	151	161	170	178
Supply	131	141	151	161	170	178
Groundwater	131	141	151	161	170	178
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Orange Grove						
Demand	476	506	534	566	596	625
Supply	476	506	534	566	596	625
Groundwater	476	506	534	566	596	625
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Premont						
Demand	709	752	791	841	886	928
Supply	709	752	791	841	886	928
Groundwater	709	752	791	841	886	928
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
San Diego MUD 1						
Demand	174	180	186	192	198	204
Supply	174	180	186	192	198	204
Groundwater	174	180	186	192	198	204
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County-Other						
Demand	2,095	2,201	2,303	2,432	2,562	2,687
Supply	37	37	37	37	37	37
Groundwater	37	37	37	37	37	37
Surface Water	-	-	-	-	-	-
Balance	(2,058)	(2,164)	(2,266)	(2,395)	(2,525)	(2,650)
County Total						
Demand	8,079	8,524	8,943	9,459	9,960	10,434
Supply	6,021	6,360	6,677	7,064	7,435	7,784
Groundwater	1,527	1,616	1,699	1,797	1,887	1,972
Surface Water	4,494	4,744	4,978	5,267	5,548	5,812
Balance	(2,058)	(2,164)	(2,266)	(2,395)	(2,525)	(2,650)

4A.3.6 Comparison of Demand to Supply – Kenedy County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.12 for all categories of water use. Table 4A.13 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 244 ac-ft in 2020 to 263 ac-ft in 2070.
- Mining demand decreases from 118 ac-ft in 2020 to 27 ac-ft in 2070.
- Livestock demand is constant at 735 ac-ft.

Supplies

- Surface water for livestock needs is provided from on-farm and local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- All municipal, and agriculture demands are met through 2070.
- Mining shows a projected shortage of 58 ac-ft/yr in 2020, decreasing to 8 ac-ft/yr in 2050 and to zero in 2060 and 2070.

Table 4A.12. Kenedy County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		463	498	504	507	508	508
	Supply and Demand by Type of Use	**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.13)	244	260	262	263	263	263
	Municipal Existing Supply						
	Groundwater	244	260	262	263	263	263
	Surface water	0	0	0	0	0	0
	Total Existing Municipal Supply	244	260	262	263	263	263
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	0	0	0	0	0	0
	Manufacturing Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	118	123	92	68	43	27
	Mining Existing Supply						
	Groundwater	60	60	60	60	43	27
	Surface water	0	0	0	0	0	0
	Total Mining Supply	60	60	60	60	43	27
	Mining Balance	(58)	(63)	(32)	(8)	0	0
Agriculture	Irrigation Demand	0	0	0	0	0	0
	Irrigation Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	0	0	0	0	0	0
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	735	735	735	735	735	735
	Livestock Existing Supply						
	Groundwater	735	735	735	735	735	735
	Surface water	0	0	0	0	0	0
	Total Livestock Supply	735	735	735	735	735	735
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	362	383	354	331	306	290
	Existing Municipal and Industrial Supply						
	Groundwater	304	320	322	323	306	290
	Surface water	0	0	0	0	0	0
	Total Municipal and Industrial Supply	304	320	322	323	306	290
	Municipal and Industrial Balance	(58)	(63)	(32)	(8)	0	0
	Agriculture Demand	735	735	735	735	735	735
	Existing Agricultural Supply						
	Groundwater	735	735	735	735	735	735
	Surface water	0	0	0	0	0	0
	Total Agriculture Supply	735	735	735	735	735	735
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	1,097	1,118	1,089	1,066	1,041	1,025
	Total Supply						
	Groundwater	1,039	1,055	1,057	1,058	1,041	1,025
	Surface water	0	0	0	0	0	0
	Total Supply	1,039	1,055	1,057	1,058	1,041	1,025
	Total Balance	(58)	(63)	(32)	(8)	0	0

Table 4A.13.
Kenedy County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
County-Other						
Demand	244	260	262	263	263	263
Supply	244	260	262	263	263	263
Groundwater	244	260	262	263	263	263
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County Total						
Demand	244	260	262	263	263	263
Supply	244	260	262	263	263	263
Groundwater	244	260	262	263	263	263
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-

4A.3.7 Comparison of Demand to Supply – Kleberg County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.14 for all categories of water use. Table 4A.15 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 5,409 ac-ft in 2020 to 7,241 ac-ft in 2070.
- Manufacturing demand increases from 2,166 ac-ft/yr in 2020 to 2,354 ac-ft/yr in 2070.
- Mining demand decreases from 357 ac-ft in 2020 to 324 ac-ft in 2050 to 298 ac-ft in 2070.
- For the period 2020 to 2070, irrigation demand is constant at 850 ac-ft; livestock demand is constant at 673 ac-ft.

Supplies

- Surface water is supplied to municipal users from the CCR/LCC/Texana/MRP Phase II System via the STWA.
- Groundwater supplies are from the Gulf Coast Aquifer and limited by water well capacity which was estimated based on TWDB historical water use records from 2010-2015. There is sufficient MAG available.

Comparison of Demand to Supply

- The City of Kingsville supplies its own groundwater and purchases surface water from the STWA and no projected municipal or agricultural shortages through 2070.
- Manufacturing has a projected shortage of 247 ac-ft/yr in 2030 and remains constant through 2070.
- Mining has a projected shortage that decreases from 139 ac-ft/yr in 2020 to 80 ac-ft/yr in 2070.

Table 4A.14.
Kleberg County Population, Water Supply, and Water Demand Projections

		2020	2030	2040	2050	2060	2070
Population Projection		35,567	38,963	42,202	45,324	48,251	50,989
Supply and Demand by Type of Use		**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.15)	5,409	5,744	6,078	6,457	6,857	7,241
	Municipal Existing Supply						
	Groundwater	4,606	4,835	5,115	5,428	5,500	5,697
	Surface water	803	909	964	1,029	1,357	1,544
	Total Existing Municipal Supply	5,409	5,744	6,078	6,457	6,857	7,241
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	1,809	2,056	2,056	2,056	2,056	2,056
	Manufacturing Existing Supply						
	Groundwater	1,809	1,809	1,809	1,809	1,809	1,809
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	1,809	1,809	1,809	1,809	1,809	1,809
	Manufacturing Balance	0	(247)	(247)	(247)	(247)	(247)
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	357	360	340	324	308	298
	Mining Existing Supply						
	Groundwater	218	218	218	218	218	218
	Surface water	0	0	0	0	0	0
	Total Mining Supply	218	218	218	218	218	218
	Mining Balance	(139)	(142)	(122)	(106)	(90)	(80)
Agriculture	Irrigation Demand	850	850	850	850	850	850
	Irrigation Existing Supply						
	Groundwater	850	850	850	850	850	850
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	850	850	850	850	850	850
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	673	673	673	673	673	673
	Livestock Existing Supply						
	Groundwater	673	673	673	673	673	673
	Surface water	0	0	0	0	0	0
	Total Livestock Supply	673	673	673	673	673	673
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	7,575	8,160	8,474	8,837	9,221	9,595
	Existing Municipal and Industrial Supply						
	Groundwater	6,633	6,862	7,142	7,455	7,527	7,724
	Surface water	803	909	964	1,029	1,357	1,544
	Total Municipal and Industrial Supply	7,436	7,771	8,105	8,484	8,884	9,268
	Municipal and Industrial Balance	(139)	(389)	(369)	(353)	(337)	(327)
	Agriculture Demand	1,523	1,523	1,523	1,523	1,523	1,523
	Existing Agricultural Supply						
	Groundwater	1,523	1,523	1,523	1,523	1,523	1,523
	Surface water	0	0	0	0	0	0
	Total Agriculture Supply	1,523	1,523	1,523	1,523	1,523	1,523
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	9,098	9,683	9,997	10,360	10,744	11,118
	Total Supply						
	Groundwater	8,156	8,385	8,665	8,978	9,050	9,247
	Surface water	803	909	964	1,029	1,357	1,544
	Total Supply	8,959	9,294	9,628	10,007	10,407	10,791
	Total Balance	(139)	(389)	(369)	(353)	(337)	(327)

Table 4A.15. Kleberg County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Baffin Bay WSC						
Demand	237	253	268	285	303	320
Supply	237	253	268	285	303	320
Groundwater	237	253	268	285	303	320
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Kingsville						
Demand	4,205	4,453	4,706	4,992	5,301	5,599
Supply	4,205	4,453	4,706	4,992	5,301	5,599
Groundwater	3,781	3,946	4,168	4,415	4,424	4,561
Surface Water	424	507	538	577	877	1,038
Balance	-	-	-	-	-	-
Naval Air Station						
Demand	256	284	303	327	347	366
Supply	256	284	303	327	347	366
Groundwater	256	284	303	327	347	366
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Ricardo WSC						
Demand	340	361	382	405	430	454
Supply	340	361	382	405	430	454
Groundwater	-	-	-	-	-	-
Surface Water	340	361	382	405	430	454
Balance	-	-	-	-	-	-
Riviera Water System						
Demand	114	121	129	137	145	153
Supply	114	121	129	137	145	153
Groundwater	114	121	129	137	145	153
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County-Other						
Demand	257	272	290	311	331	349
Supply	257	272	290	311	331	349
Groundwater	218	231	247	264	281	297
Surface Water	39	41	44	47	50	52
Balance	-	-	-	-	-	-
County Total						
Demand	5,409	5,744	6,078	6,457	6,857	7,241
Supply	5,409	5,744	6,078	6,457	6,857	7,241
Groundwater	4,606	4,835	5,115	5,428	5,500	5,697
Surface Water	803	909	964	1,029	1,357	1,544
Balance	-	-	-	-	-	-

4A.3.8 Comparison of Demand to Supply – Live Oak County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.16 for all categories of water use. Table 4A.17 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand decreases from 1,816 ac-ft in 2020 to 1,716 ac-ft in 2050 then to 1,703 ac-ft in 2070.
- Manufacturing demands increase from 2,274 ac-ft in 2020 to 2,493 ac-ft in 2070.
- Mining demand decreases from 814 ac-ft to 332 ac-ft from 2020 to 2070.
- For the period 2020 to 2070, irrigation demand remains constant at 1,630 ac-ft; livestock demand is constant at 740 ac-ft.

Supplies

- Surface water is supplied from the CCR/LCC reservoirs for the City of Three Rivers and manufacturing customers according to contract. Some livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Carrizo-Wilcox and Gulf Coast Aquifers.

Comparison of Demand to Supply

- There are no projected municipal water shortages in the County through the planning period.
- Manufacturing has a projected shortage of 28 ac-ft/yr in 2030 that remains constant through 2070.
- Irrigation shows an increasing shortage of 343 ac-ft/yr in 2020 and 534 ac-ft/yr in 2070.

Table 4A.16.
Live Oak County Population, Water Supply, and Water Demand Projections

	Population Projection	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
		11,683	11,690	11,690	11,690	11,690	11,690
	Supply and Demand by Type of Use	**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.17)	1,816	1,770	1,733	1,716	1,703	1,703
	Municipal Existing Supply						
	Groundwater	1,271	1,240	1,215	1,204	1,192	1,192
	Surface water	545	530	518	512	511	511
	Total Existing Municipal Supply	1,816	1,770	1,733	1,716	1,703	1,703
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	2,274	2,493	2,493	2,493	2,493	2,493
	Manufacturing Existing Supply						
	Groundwater	965	965	965	965	965	965
	Surface water	1,309	1,500	1,500	1,500	1,500	1,500
	Total Manufacturing Supply	2,274	2,465	2,465	2,465	2,465	2,465
	Manufacturing Balance	0	(28)	(28)	(28)	(28)	(28)
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	814	917	907	729	492	332
	Mining Existing Supply						
	Groundwater	814	917	907	729	492	332
	Surface water	0	0	0	0	0	0
	Total Mining Supply	814	917	907	729	492	332
	Mining Balance	0	0	0	0	0	0
Agriculture	Irrigation Demand	1,630	1,630	1,630	1,630	1,630	1,630
	Irrigation Existing Supply						
	Groundwater	1,096	1,096	1,096	1,096	1,096	1,096
	Surface water	191	0	0	0	0	0
	Total Irrigation Supply	1,287	1,096	1,096	1,096	1,096	1,096
	Irrigation Balance	(343)	(534)	(534)	(534)	(534)	(534)
	Livestock Demand	740	740	740	740	740	740
	Livestock Existing Supply						
	Groundwater	529	529	529	529	529	529
	Surface water	211	211	211	211	211	211
	Total Livestock Supply	740	740	740	740	740	740
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	4,904	5,180	5,133	4,938	4,688	4,528
	Existing Municipal and Industrial Supply						
	Groundwater	3,050	3,122	3,087	2,898	2,649	2,489
	Surface water	1,854	2,030	2,018	2,012	2,011	2,011
	Total Municipal and Industrial Supply	4,904	5,152	5,105	4,910	4,660	4,500
	Municipal and Industrial Balance	0	(28)	(28)	(28)	(28)	(28)
	Agriculture Demand	2,370	2,370	2,370	2,370	2,370	2,370
	Existing Agricultural Supply						
	Groundwater	1,625	1,625	1,625	1,625	1,625	1,625
	Surface water	402	211	211	211	211	211
	Total Agriculture Supply	2,027	1,836	1,836	1,836	1,836	1,836
	Agriculture Balance	(343)	(534)	(534)	(534)	(534)	(534)
	Total Demand	7,274	7,550	7,503	7,308	7,058	6,898
	Total Supply						
	Groundwater	4,675	4,747	4,712	4,523	4,274	4,114
	Surface water	2,256	2,241	2,229	2,223	2,222	2,222
	Total Supply	6,931	6,988	6,941	6,746	6,496	6,336
	Total Balance	(343)	(562)	(562)	(562)	(562)	(562)

Table 4A.17. Live Oak County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
El Oso WSC						
Demand	178	174	171	169	160	160
Supply	178	174	171	169	160	160
Groundwater	178	174	171	169	160	160
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
George West						
Demand	435	424	414	411	410	410
Supply	435	424	414	411	410	410
Groundwater	435	424	414	411	410	410
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
McCoy WSC						
Demand	21	20	20	20	20	20
Supply	21	20	20	20	20	20
Groundwater	21	20	20	20	20	20
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Three Rivers						
Demand	545	530	518	512	511	511
Supply	545	530	518	512	511	511
Groundwater	-	-	-	-	-	-
Surface Water	545	530	518	512	511	511
Balance	-	-	-	-	-	-
County-Other						
Demand	637	622	610	604	602	602
Supply	637	622	610	604	602	602
Groundwater	637	622	610	604	602	602
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County Total						
Demand	1,816	1,770	1,733	1,716	1,703	1,703
Supply	1,816	1,770	1,733	1,716	1,703	1,703
Groundwater	1,271	1,240	1,215	1,204	1,192	1,192
Surface Water	545	530	518	512	511	511
Balance	-	-	-	-	-	-

4A.3.9 Comparison of Demand to Supply – McMullen County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.18 for all categories of water use. Table 4A.19 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand decreases from 97 ac-ft in 2020 to 89 ac-ft in 2070.
- Manufacturing demand increases from 219 ac-ft/yr in 2020 to 249 ac-ft/yr in 2070.
- Mining demand decreases from 4,268 ac-ft to 1,305 ac-ft from 2020 to 2070.
- Livestock demand is constant at 355 ac-ft.

Supplies

- Groundwater supplies are from the Carrizo-Wilcox and Gulf Coast Aquifers.
- Surface water for livestock needs is met by on-farm/local sources.

Comparison of Demand to Supply

- There are adequate supplies available to meet all projected demands through the planning period.

Table 4A.18. McMullen County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		734	734	734	734	734	734
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand (See Table 4A.19)	97	94	91	89	89	89
	Municipal Existing Supply						
	Groundwater	97	94	91	89	89	89
	Surface water	0	0	0	0	0	0
	Total Existing Municipal Supply	97	94	91	89	89	89
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	219	249	249	249	249	249
	Manufacturing Existing Supply						
	Groundwater	219	249	249	249	249	249
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	219	249	249	249	249	249
	Manufacturing Balance	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	4,268	4,804	4,754	2,622	1,850	1,305
	Mining Existing Supply						
	Groundwater	4,268	4,804	4,754	2,622	1,850	1,305
	Surface water	0	0	0	0	0	0
	Total Mining Supply	4,268	4,804	4,754	2,622	1,850	1,305
	Mining Balance	0	0	0	0	0	0
Agriculture	Irrigation Demand	0	0	0	0	0	0
	Irrigation Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	0	0	0	0	0	0
	Irrigation Balance	0	0	0	0	0	0
	Livestock Demand	335	335	335	335	335	335
	Livestock Existing Supply						
	Groundwater	56	56	40	40	40	40
	Surface water	279	279	295	295	295	295
	Total Livestock Supply	335	335	335	335	335	335
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	4,584	5,147	5,094	2,960	2,188	1,643
	Existing Municipal and Industrial Supply						
	Groundwater	4,584	5,147	5,094	2,960	2,188	1,643
	Surface water	0	0	0	0	0	0
	Total Municipal and Industrial Supply	4,584	5,147	5,094	2,960	2,188	1,643
	Municipal and Industrial Balance	0	0	0	0	0	0
	Agriculture Demand	335	335	335	335	335	335
	Existing Agricultural Supply						
	Groundwater	56	56	40	40	40	40
	Surface water	279	279	295	295	295	295
	Total Agriculture Supply	335	335	335	335	335	335
	Agriculture Balance	0	0	0	0	0	0
	Total Demand	4,919	5,482	5,429	3,295	2,523	1,978
	Total Supply						
	Groundwater	4,640	5,203	5,134	3,000	2,228	1,683
	Surface water	279	279	295	295	295	295
	Total Supply	4,919	5,482	5,429	3,295	2,523	1,978
	Total Balance	0	0	0	0	0	0

Table 4A.19.
McMullen County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
County-Other						
Demand	97	94	91	89	89	89
Supply	97	94	91	89	89	89
Groundwater	97	94	91	89	89	89
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
County Total						
Demand	97	94	91	89	89	89
Supply	97	94	91	89	89	89
Groundwater	97	94	91	89	89	89
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-

4A.3.10 Comparison of Demand to Supply – Nueces County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.20 for all categories of water use. Table 4A.21 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 74,908 ac-ft in 2020 to 86,589 ac-ft in 2070.
- Manufacturing demand increases from 45,411 ac-ft in 2020 to 50,363 ac-ft in 2070.
- Mining demand increases from 724 ac-ft in 2020 to 1,260 ac-ft in 2070; steam-electric demand remains constant at 2,077 ac-ft/yr.
- For the period 2020 to 2070, irrigation demand is constant at 1,540 ac-ft; livestock demand is constant at 291 ac-ft.

Supplies

- Surface water is supplied from the CCR/LCC/Texana/MRP Phase II System, SPMWD, STWA, and Nueces County WCID #3; some livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- Nueces County WCID #3 provides water to the City of Robstown and River Acres WSC. Nueces County WCID #3 (Robstown) has shortages from 2020 to 2070, with the greatest shortage of 3,812 ac-ft in 2020. Nueces County WCID # 3 provides water supplies to River Acres WSC, with shortages increasing from 234 ac-ft in 2020 to 293 ac-ft in 2070. Shortages are attributed to water supply limits during drought of record conditions. A small, local balancing storage reservoir is recommended for Nueces County WCID #3 use during drought events to firm up water to meet customers' needs in full through 2070.
- County-Other receives water supplies from the City of Corpus Christi, STWA, and Nueces County WCID #3 that were distributed based on TWDB information provided for County-Other entities and existing contracts in place. County-Other demonstrates a projected shortage of 1,245 ac-ft/yr in 2020 increasing to 1,364 ac-ft/yr in 2070.
- Manufacturing has shortages ranging from 9,084 ac-ft/yr in 2030 to 16,587 ac-ft/yr in 2070. The shortages are attributable to both raw water and water treatment plant constraints.
- Steam-Electric is not projected to have a shortage during the planning period.
- Mining has shortages ranging from 629 ac-ft/yr in 2020 to 1,127 ac-ft/yr in 2070. The shortages are attributable to both raw water and treatment plant constraints.
- Irrigation has a constant shortage of 51 ac-ft/yr from 2020 to 2070.
- There are sufficient livestock supplies through 2070.

Table 4A.20.
Nueces County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		374,157	407,534	428,513	440,797	449,936	456,056
	Supply and Demand by Type of Use	**Year**					
		2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Municipal	Municipal Demand (See Table 4A.21)	74,908	79,586	82,244	83,865	85,444	86,589
	Municipal Existing Supply						
	Groundwater	313	313	313	313	313	313
	Surface water	69,304	73,859	76,471	78,098	79,690	80,883
	Total Existing Municipal Supply	69,617	74,172	76,784	78,411	80,003	81,196
	Municipal Balance	(5,291)	(5,414)	(5,460)	(5,454)	(5,441)	(5,393)
Industrial	Manufacturing Demand	45,411	50,363	50,363	50,363	50,363	50,363
	Manufacturing Existing Supply						
	Groundwater	776	802	802	802	802	802
	Surface water	44,635	40,477	37,876	36,222	34,333	32,974
	Total Manufacturing Supply	45,411	41,279	38,678	37,024	35,135	33,776
	Manufacturing Balance	0	(9,084)	(11,685)	(13,339)	(15,228)	(16,587)
	Steam-Electric Demand	2,077	2,077	2,077	2,077	2,077	2,077
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	2,077	2,077	2,077	2,077	2,077	2,077
	Total Steam-Electric Supply	2,077	2,077	2,077	2,077	2,077	2,077
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	724	853	947	1,021	1,130	1,260
	Mining Existing Supply						
	Groundwater	95	104	111	116	124	133
	Surface water	0	0	0	0	0	0
	Total Mining Supply	95	104	111	116	124	133
	Mining Balance	(629)	(749)	(836)	(905)	(1,006)	(1,127)
Agriculture	Irrigation Demand	1,540	1,540	1,540	1,540	1,540	1,540
	Irrigation Existing Supply						
	Groundwater	1,489	1,489	1,489	1,489	1,489	1,489
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	1,489	1,489	1,489	1,489	1,489	1,489
	Irrigation Balance	(51)	(51)	(51)	(51)	(51)	(51)
	Livestock Demand	291	291	291	291	291	291
	Livestock Existing Supply						
	Groundwater	241	241	241	241	241	241
	Surface water	50	50	50	50	50	50
	Total Livestock Supply	291	291	291	291	291	291
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	123,120	132,879	135,631	137,326	139,014	140,289
	Existing Municipal and Industrial Supply						
	Groundwater	1,184	1,219	1,226	1,231	1,239	1,248
	Surface water	116,016	109,354	106,891	104,287	101,395	98,371
	Total Municipal and Industrial Supply	117,200	110,573	108,117	105,518	102,634	99,619
	Municipal and Industrial Balance	(5,920)	(22,306)	(27,514)	(31,808)	(36,380)	(40,670)
	Agriculture Demand	1,831	1,831	1,831	1,831	1,831	1,831
	Existing Agricultural Supply						
	Groundwater	1,730	1,730	1,730	1,730	1,730	1,730
	Surface water	50	50	50	50	50	50
	Total Agriculture Supply	1,780	1,780	1,780	1,780	1,780	1,780
	Agriculture Balance	(51)	(51)	(51)	(51)	(51)	(51)
	Total Demand	124,951	134,710	137,462	139,157	140,845	142,120
	Total Supply						
	Groundwater	2,914	2,949	2,956	2,961	2,969	2,978
	Surface water	116,066	109,404	106,941	104,337	101,445	98,421
	Total Supply	118,980	96,675	94,265	91,766	88,991	86,063
	Total Balance	(5,971)	(22,357)	(27,565)	(31,859)	(36,431)	(40,721)

Table 4A.21.
Nueces County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	2020	2030	2040	2050	2060	2070
Aransas Pass						
Demand	2	2	2	2	2	2
Supply	2	2	2	2	2	2
Groundwater	-	-	-	-	-	-
Surface Water	2	2	2	2	2	2
Balance	-	-	-	-	-	-
Bishop						
Demand	593	627	645	660	672	681
Supply	593	627	645	660	672	681
Groundwater	282	282	282	282	282	282
Surface Water	311	345	363	378	390	399
Balance	-	-	-	-	-	-
Corpus Christi						
Demand	64,110	68,180	70,493	71,888	73,258	74,240
Supply	64,110	68,180	70,493	71,888	73,258	74,240
Groundwater	-	-	-	-	-	-
Surface Water	64,110	68,180	70,493	71,888	73,258	74,240
Balance	-	-	-	-	-	-
Corpus Christi Naval Air Station						
Demand	1,085	1,178	1,237	1,271	1,296	1,315
Supply	1,085	1,178	1,237	1,271	1,296	1,315
Groundwater	-	-	-	-	-	-
Surface Water	1,085	1,178	1,237	1,271	1,296	1,315
Balance	-	-	-	-	-	-
Driscoll						
Demand	105	110	112	114	116	117
Supply	105	110	112	114	116	117
Groundwater	-	-	-	-	-	-
Surface Water	105	110	112	114	116	117
Balance	-	-	-	-	-	-
Nueces County WCID 3						
Demand	4,004	3,992	3,952	3,933	3,929	3,928
Supply	192	192	192	192	192	192
Groundwater	-	-	-	-	-	-
Surface Water	192	192	192	192	192	192
Balance	(3,812)	(3,800)	(3,760)	(3,741)	(3,737)	(3,736)
Nueces County WCID 4						
Demand	2,465	2,661	2,782	2,854	2,912	2,951
Supply	2,465	2,661	2,782	2,854	2,912	2,951
Groundwater	-	-	-	-	-	-
Surface Water	2,465	2,661	2,782	2,854	2,912	2,951
Balance	-	-	-	-	-	-

City/County	2020	2030	2040	2050	2060	2070
Nueces WSC						
Demand	457	589	668	762	871	999
Supply	457	589	668	762	871	999
Groundwater	-	-	-	-	-	-
Surface Water	457	589	668	762	871	999
Balance	-	-	-	-	-	-
River Acres WSC						
Demand	426	450	462	470	479	485
Supply	192	192	192	192	192	192
Groundwater	-	-	-	-	-	-
Surface Water	192	192	192	192	192	192
Balance	(234)	(258)	(270)	(278)	(287)	(293)
Violet WSC						
Demand	186	193	196	198	201	204
Supply	186	193	196	198	201	204
Groundwater	-	-	-	-	-	-
Surface Water	186	193	196	198	201	204
Balance	-	-	-	-	-	-
County-Other						
Demand	1,475	1,604	1,695	1,713	1,708	1,667
Supply	230	248	265	278	291	303
Groundwater	31	31	31	31	31	31
Surface Water	199	217	234	247	260	272
Balance	(1,245)	(1,356)	(1,430)	(1,435)	(1,417)	(1,364)
County Total						
Demand	74,908	79,586	82,244	83,865	85,444	86,589
Supply	69,617	74,172	76,784	78,411	80,003	81,196
Groundwater	313	313	313	313	313	313
Surface Water	69,304	73,859	76,471	78,098	79,690	80,883
Balance	(5,291)	(5,414)	(5,460)	(5,454)	(5,441)	(5,393)

4A.3.11 Comparison of Demand to Supply – San Patricio County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2020 through 2070 period in Table 4A.22 for all categories of water use. Table 4A.23 includes a summary of municipal demands.

Demands

- For the period 2020 to 2070, municipal demand increases from 10,255 ac-ft in 2020 to 10,783 ac-ft in 2070.
- Manufacturing demand increases from 38,841 ac-ft in 2020 to 43,223 ac-ft in 2070.
- Mining increases from 372 ac-ft in 2020 to 533 ac-ft in 2070.
- For the period 2020 to 2070, irrigation demand is constant at 14,645 ac-ft; livestock demand is constant at 396 ac-ft.

Supplies

- Surface water is supplied from the CCR/LCC/Texana/MRP Phase II System; the SPMWD has a contract to purchase up to 53,676 ac-ft/yr in 2020 and 73,800 ac-ft/yr after 2020, which includes 46,800 ac-ft/yr raw and 27,000 ac-ft/yr treated water. Municipal water supplies are prioritized according to water demands and contracts. Total municipal and industrial supplies for San Patricio County decline over time as a result of reservoir sedimentation conditions and increases in municipal water use in other counties served by the City of Corpus. San Patricio County manufacturing shortages are attributed to insufficient current supplies, not contracts. Some livestock demands are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.
- Groundwater supply for irrigation was set equal to the maximum historical pumping (i.e. estimated well capacity).

Comparison of Demand to Supply

- There are no projected municipal shortages during the planning period.
- Manufacturing has projected shortages from 7,059 ac-ft/yr in 2030 to 17,563 ac-ft in 2070 as a result of both raw water constraints and SPMWD treatment plant constraints.
- Mining has projected shortages from 237 ac-ft/yr in 2020 to 398 ac-ft in 2070 as a result of both raw water constraints and treatment plant constraints.
- There are sufficient steam-electric supplies through the year 2070.
- Supplies for irrigation are constrained by well capacity, resulting in an irrigation shortage of 204 ac-ft/yr through 2070.
- There are sufficient livestock supplies through the year 2070.

Table 4A.22. San Patricio County Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		68,760	72,114	74,043	75,451	76,405	77,049
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand (See Table 4A.23)	10,255	10,437	10,495	10,587	10,696	10,783
	Municipal Existing Supply						
	Groundwater	1,549	1,589	1,607	1,626	1,644	1,656
	Surface water	8,706	8,848	8,888	8,961	9,052	9,127
	Total Existing Municipal Supply	10,255	10,437	10,495	10,587	10,696	10,783
	Municipal Balance	0	0	0	0	0	0
Industrial	Manufacturing Demand	38,841	43,223	43,223	43,223	43,223	43,223
	Manufacturing Existing Supply						
	Groundwater	25	25	25	25	25	25
	Surface water	39,006	36,139	33,665	31,087	28,493	25,635
	Total Manufacturing Supply	39,031	36,164	33,690	31,112	28,518	25,660
	Manufacturing Balance	190	(7,059)	(9,533)	(12,111)	(14,705)	(17,563)
	Steam-Electric Demand	1,919	1,919	1,919	1,919	1,919	1,919
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	1,919	1,919	1,919	1,919	1,919	1,919
	Total Steam-Electric Supply	1,919	1,919	1,919	1,919	1,919	1,919
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	372	421	440	460	492	533
	Mining Existing Supply						
	Groundwater	135	135	135	135	135	135
	Surface water	0	0	0	0	0	0
	Total Mining Supply	135	135	135	135	135	135
	Mining Balance	(237)	(286)	(305)	(325)	(357)	(398)
Agriculture	Irrigation Demand	14,645	14,645	14,645	14,645	14,645	14,645
	Irrigation Existing Supply						
	Groundwater	14,441	14,441	14,441	14,441	14,441	14,441
	Surface water	0	0	0	0	0	0
	Total Irrigation Supply	14,441	14,441	14,441	14,441	14,441	14,441
	Irrigation Balance	(204)	(204)	(204)	(204)	(204)	(204)
	Livestock Demand	396	396	396	396	396	396
	Livestock Existing Supply						
	Groundwater	233	233	233	233	233	233
	Surface water	163	163	163	163	163	163
	Total Livestock Supply	396	396	396	396	396	396
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	51,387	56,000	56,077	56,189	56,330	56,458
	Existing Municipal and Industrial Supply						
	Groundwater	1,709	1,749	1,767	1,786	1,804	1,816
	Surface water	49,631	46,906	44,471	41,968	39,464	36,681
	Total Municipal and Industrial Supply	51,340	48,655	46,239	43,753	41,268	38,497
	Municipal and Industrial Balance	(47)	(7,345)	(9,838)	(12,436)	(15,062)	(17,961)
	Agriculture Demand	15,041	15,041	15,041	15,041	15,041	15,041
	Existing Agricultural Supply						
	Groundwater	14,674	14,674	14,674	14,674	14,674	14,674
	Surface water	163	163	163	163	163	163
	Total Agriculture Supply	14,837	14,837	14,837	14,837	14,837	14,837
	Agriculture Balance	(204)	(204)	(204)	(204)	(204)	(204)
	Total Demand	66,428	71,041	71,118	71,230	71,371	71,499
	Total Supply						
	Groundwater	16,383	16,423	16,441	16,460	16,478	16,490
	Surface water	49,794	47,069	44,634	42,131	39,627	36,844
	Total Supply	66,177	63,492	61,076	58,590	56,105	53,334
	Total Balance	(251)	(7,549)	(10,042)	(12,640)	(15,266)	(18,165)

Table 4A.23. San Patricio County Municipal Water Demand and Supply by City/County (ac-ft)

City/County	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Aransas Pass						
Demand	1,370	1,391	1,392	1,399	1,414	1,425
Supply	1,370	1,391	1,392	1,399	1,414	1,425
Groundwater	-	-	-	-	-	-
Surface Water	1,370	1,391	1,392	1,399	1,414	1,425
Balance	-	-	-	-	-	-
Gregory						
Demand	339	344	348	354	357	360
Supply	339	344	348	354	357	360
Groundwater	-	-	-	-	-	-
Surface Water	339	344	348	354	357	360
Balance	-	-	-	-	-	-
Ingleside						
Demand	1,013	1,024	1,023	1,026	1,036	1,044
Supply	1,013	1,024	1,023	1,026	1,036	1,044
Groundwater	-	-	-	-	-	-
Surface Water	1,013	1,024	1,023	1,026	1,036	1,044
Balance	-	-	-	-	-	-
Mathis						
Demand	653	658	655	661	668	673
Supply	653	658	655	661	668	673
Groundwater	-	-	-	-	-	-
Surface Water	653	658	655	661	668	673
Balance	-	-	-	-	-	-
Odem						
Demand	395	401	401	404	408	411
Supply	395	401	401	404	408	411
Groundwater	-	-	-	-	-	-
Surface Water	395	401	401	404	408	411
Balance	-	-	-	-	-	-
Portland						
Demand	3,389	3,458	3,477	3,503	3,539	3,569
Supply	3,389	3,458	3,477	3,503	3,539	3,569
Groundwater	-	-	-	-	-	-
Surface Water	3,389	3,458	3,477	3,503	3,539	3,569
Balance	-	-	-	-	-	-
Rincon WSC						
Demand	368	377	381	385	389	392
Supply	368	377	381	385	389	392
Groundwater	-	-	-	-	-	-
Surface Water	368	377	381	385	389	392
Balance	-	-	-	-	-	-

City/County	2020	2030	2040	2050	2060	2070
Sinton						
Demand	1,345	1,382	1,396	1,411	1,427	1,438
Supply	1,345	1,382	1,396	1,411	1,427	1,438
Groundwater	1,345	1,382	1,396	1,411	1,427	1,438
Surface Water	-	-	-	-	-	-
Balance	-	-	-	-	-	-
Taft						
Demand	540	546	545	552	558	563
Supply	540	546	545	552	558	563
Groundwater	-	-	-	-	-	-
Surface Water	540	546	545	552	558	563
Balance	-	-	-	-	-	-
County-Other						
Demand	843	856	877	892	900	908
Supply	843	856	877	892	900	908
Groundwater	204	207	211	215	217	218
Surface Water	639	649	666	677	683	690
Balance	-	-	-	-	-	-
County Total						
Demand	10,255	10,437	10,495	10,587	10,696	10,783
Supply	10,255	10,437	10,495	10,587	10,696	10,783
Groundwater	1,549	1,589	1,607	1,626	1,644	1,656
Surface Water	8,706	8,848	8,888	8,961	9,052	9,127
Balance	-	-	-	-	-	-

4A.4 Major Water Providers – Comparison of Demand and Supply

The Coastal Bend Region has four current wholesale water providers[3]: the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID #3. These current WWPs were designated major water providers (MWPs) by the CBRWPG.

The City of Corpus Christi provides water to SPMWD and STWA, who then supply water to their customers, as shown previously in Figure 3.3. SPMWD is projected to receive up to 53,486 ac-ft/yr of raw and treated water in 2020 from the City according to their contract. SPMWD is contracted to receive up to 73,800 ac-ft/yr from the City of Corpus Christi. Current supplies are not adequate to fulfill this contract in full and the City of Corpus Christi and SPMWD are working together to develop future water management strategies, accordingly. The most typical contract between the City and its other customers includes providing water at the greater amount supplied in previous years plus 10 percent. When projecting customer supplies (2020 to 2070), it was assumed that either: 1) supply increased each year by 10 percent; or 2) supply was equal to demand, whichever is less.

4A.4.1 Safe Yield Supply to Demands

The Coastal Bend Region adopted use of safe yield supply for the three largest wholesale water providers: City of Corpus Christi, SPMWD, and STWA and their customers. The safe yield supplies assume a reserve of 75,000 ac-ft as a drought management strategy to plan for future droughts greater than the drought of record. Table 4A.24 shows the safe yield water supply for each MWP, the amount of water supplied to each customer, and resulting water surplus or shortage after meeting customer needs. This analysis is shown for both the raw water and treated water components of the City of Corpus Christi and SPMWD customer systems. However, treated and raw water shortages are not additive, but are instead shown in the table only to differentiate raw water source shortages. As discussed earlier, the larger of the raw water or treated water plant capacity shortages by decade are used for planning purposes. STWA and their customers receive only treated water supplies. The City of Corpus Christi safe yield water supply for 2020 is 178,000 ac-ft, which includes supplies from the CCR/LCC System, a base amount of 31,440 ac-ft/yr and interruptible supplies from Lake Texana during the drought of record, and up to 35,000 ac-ft/yr from the City owned Garwood water rights according to availability. This System supply diminishes to 167,000 ac-ft by 2070 because of reservoir sedimentation.

[3] The Port of Corpus Christi Authority (PCCA) and Poseidon Water are potential future WWPs for recommended water management based on TWDB DB22 requirements. However, water supply plans are not included for them since they are not current WWPs and were not identified as WWPs by the CBRWPG.

Table 4A.24.
Major Water Provider Surface Water Allocation

Major Water Provider (Water User/County)	2020	2030	2040	2050	2060	2070
City of Corpus Christi						
Safe Yield Supply	**178,000**	**176,100**	**173,900**	**171,700**	**169,500**	**167,000**
Current Treatment Capacity	128,114	128,114	128,114	128,114	128,114	128,114
Raw Water Available for Sales[1]	52,828	47,986	45,786	43,586	41,386	38,886
Raw Water Supply/Needs Analysis						
Raw Water Demand						
Municipal						
Jim Wells County						
Alice	4,494	4,744	4,978	5,267	5,548	5,812
Bee County						
Beeville	1,925	1,986	1,983	1,966	1,964	1,965
San Patricio County						
Mathis	653	658	655	661	668	673
San Patricio MWD[2]	38,084	46,800	46,800	46,800	46,800	46,800
Live Oak County						
Three Rivers	3,363	3,363	3,363	3,363	3,363	3,363
Non-Municipal						
Manufacturing (Nueces Couny)[3]	2,232	9,912	9,912	9,912	9,912	9,912
Steam-Electric Power (Nueces County)	2,077	2,077	2,077	2,077	2,077	2,077
Total Raw Water Demand	**52,828**	**69,540**	**69,768**	**70,046**	**70,332**	**70,602**
Raw Water Surplus/Shortage (*Contracts* based)	**0**	**(21,554)**	**(23,982)**	**(26,460)**	**(28,946)**	**(31,716)**
Raw Water Surplus/Shortage (*Needs* based)[4]	**0**	**(13,997)**	**(16,471)**	**(19,049)**	**(21,644)**	**(24,501)**
Treated Water Supply/Needs Analysis						
O.N. Stevens WTP Capacity[5]	**128,114**	**128,114**	**128,114**	**128,114**	**128,114**	**128,114**
Treated Water Demand						
Municipal						
City of Corpus Christi	64,110	68,180	70,493	71,888	73,258	74,240
Kleberg County						
South Texas Water Authority	1,875	2,170	2,341	2,530	2,994	3,331
Nueces County						
Nueces County WCID 4[6]	1,134	1,224	1,280	1,313	1,340	1,357
Corpus Christi Naval Air Station	1,085	1,178	1,237	1,271	1,296	1,315
Violet WSC	186	193	196	198	201	204
San Patricio County						
San Patricio MWD[2]	15,592	27,000	27,000	27,000	27,000	27,000
Non-Municipal						
Manufacturing- Nueces[3,7]	41,190	38,436	38,436	38,436	38,436	38,436
Total Treated Water Demand	**125,172**	**138,381**	**140,982**	**142,635**	**144,524**	**145,884**
Treated Water Surplus/Shortage (*Contracts* based)[8]	**0**	**(10,267)**	**(12,868)**	**(14,521)**	**(16,410)**	**(17,770)**
Treated Water Surplus/Shortage (*Needs* based)	**0**	**(2,146)**	**(4,747)**	**(6,400)**	**(8,289)**	**(9,649)**
Total Water Supply/Needs Analysis						
Safe Yield Supply	**178,000**	**176,100**	**173,900**	**171,700**	**169,500**	**167,000**
Total Raw and Treated Water Demands (*Contracts* Based)	**178,000**	**207,921**	**210,750**	**212,682**	**214,857**	**216,486**
Total Water Surplus/Shortage (*Contracts* based)	**0**	**(31,821)**	**(36,850)**	**(40,982)**	**(45,357)**	**(49,486)**
Total Water Surplus/Shortage (*Needs* based, includes SPMWD needs on following page)	**0**	**(16,143)**	**(21,218)**	**(25,449)**	**(29,933)**	**(34,150)**

Major Water Provider (Water User/County)	2020	2030	2040	2050	2060	2070
Contracted Purchases from the City of Corpus Christi[9]	**53,676**	**73,800**	**73,800**	**73,800**	**73,800**	**73,800**
Actual Amount that Can Be Provided based on Current Supply (acft/yr)	**53,676**	**51,063**	**48,635**	**46,157**	**43,671**	**40,901**
Amount the City Provides to Meet SPMWD Water Demands, within Contract Terms (No SPMWD surpluses)	**53,486**	**58,122**	**58,168**	**58,268**	**58,376**	**58,464**
Average Day SPMWD Industrial Treatment Available[10]	13,072	13,072	13,072	13,072	13,072	13,072
Average Day SPMWD Potable-Municipal Treatment Available[10]	14,457	14,457	14,457	14,457	14,457	14,457
Purchased Treated Water from City of Corpus Christi[9]	15,592	18,879	18,879	18,879	18,879	18,879
Total Treated Water Supply[9]	**43,121**	**46,408**	**46,408**	**46,408**	**46,408**	**46,408**
Raw Water Supply/Needs Analysis						
Raw Water Demand						
Non-Municipal						
Manufacturing- San Patricio[11]	9,704	10,800	10,800	10,800	10,800	10,800
Steam-Electric- San Patricio	1,919	1,919	1,919	1,919	1,919	1,919
Total Raw Water Demand	**11,623**	**12,719**	**12,719**	**12,719**	**12,719**	**12,719**
Treated Water Supply/Needs Analysis						
Potable-Municipal Treated Water Supply[12]	**13,199**	**13,453**	**13,499**	**13,599**	**13,707**	**13,795**
Industrial- Treated Water Supply	**28,664**	**31,951**	**31,951**	**31,951**	**31,951**	**31,951**
Treated Water Demand						
Municipal						
Aransas County						
Aransas Pass-Aransas	132	131	127	126	126	126
Rockport	3,462	3,469	3,410	3,404	3,398	3,398
County-Other, Aransas	120	118	113	112	112	112
Nueces County						
Aransas Pass-Nueces	2	2	2	2	2	2
Nueces County WCID 4[13]	1,331	1,437	1,502	1,541	1,572	1,594
County-Other, Nueces	98	106	112	113	113	110
San Patricio County						
Aransas Pass- San Patricio	1,370	1,391	1,392	1,399	1,414	1,425
Gregory	339	344	348	354	357	360
Ingleside	1,013	1,024	1,023	1,026	1,036	1,044
Odem	395	401	401	404	408	411
Portland	3,389	3,458	3,477	3,503	3,539	3,569
Rincon WSC	368	377	381	385	389	392
Taft	540	546	545	552	558	563
County-Other, San Patricio	639	649	666	677	683	690
Municipal Treated Water Demand	**13,199**	**13,453**	**13,499**	**13,599**	**13,707**	**13,795**
Non-Municipal						
Manufacturing (San Patricio County)[11]	28,664	31,951	31,951	31,951	31,951	31,951
Industrial Treated Water Demand	**28,664**	**31,951**	**31,951**	**31,951**	**31,951**	**31,951**
Total Water Supply/Needs Analysis						
Total Water Supply Available Based on Current Supply (acft/yr)	**53,676**	**51,063**	**48,635**	**46,157**	**43,671**	**40,901**
Total Raw Water and Treated Water Demands	**53,486**	**58,122**	**58,168**	**58,268**	**58,376**	**58,464**
Total Water Surplus/Shortage (Contracts Based)[14]	**–**	**(22,737)**	**(25,165)**	**(27,643)**	**(30,129)**	**(32,899)**
Total Water Surplus/Shortage (Needs Based)[12]	**190**	**(7,059)**	**(9,533)**	**(12,111)**	**(14,705)**	**(17,563)**

Major Water Provider (Water User/County)	2020	2030	2040	2050	2060	2070
South Texas Water Authority						
Total Surface Water Right	**0**	**0**	**0**	**0**	**0**	**0**
Contract Purchases	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**
Contract Sales						
Municipal						
Nueces County						
Driscoll	105	110	112	114	116	117
Bishop	311	345	363	378	390	399
Nueces WSC	457	589	668	762	871	999
County-Other, Nueces	199	217	234	247	260	272
Kleberg County						
Kingsville + County-Other	463	548	582	624	927	1,090
Ricardo WSC	340	361	382	405	430	454
Total Contract Sales	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**
Surplus/Shortage	**—**	**—**	**—**	**—**	**—**	**—**
Nueces County WCID 3						
Total Surface Water Right (firm yield)	**384**	**384**	**384**	**384**	**384**	**384**
Contract Sales						
Municipal						
Nueces County						
Wholesale Water Provider (Water User/County)						
NUECES COUNTY WCID 3	4,004	3,992	3,952	3,933	3,929	3,928
River Acres WSC	426	450	462	470	479	485
Total Contract Sales	**4,430**	**4,442**	**4,414**	**4,403**	**4,408**	**4,413**
Surplus/Shortage	**(4,046)**	**(4,058)**	**(4,030)**	**(4,019)**	**(4,024)**	**(4,029)**

1. Raw water available for sales is safe yield less contracted supplies with customers and treated water demands or treatment plant capacity, whichever is the lesser of the two.

2. The City of Corpus Christi's contract with San Patricio MWD specifies that 27,000 acft/yr treated water will be provided, and up to 46,800 acft/yr of raw water will be provide after Year 2020. For Year 2020, assumes City provides 15,592 acft/yr to meet treated demands within contracted amounts.

3. Assumed 5% of the Nueces County Manufacturing demand in Year 2020 is supplied by raw water, increasing to 20% of Nueces County Manufacturing demand supplied by raw water from Year 2030 onward as provided based on WWP projected use.

4. City of Corpus Christi municipal contracts fulfilled, except SPMWD supplies provided to meet demands for its San Patricio County customers within contract supply quantities are limited by water availability.

5. The City's ON Stevens Water Treatment Plant has a treatment plant capacity of 160 MGD. Average day treatment capacity is calculated at 113.6 MGD, or 128,114 acft/yr, after considering a peaking capacity of 1.4:1. Peak to average day ratio is based on historical data.

6. Of the total water demand for NCWCID 4 (Port Aransas), the City is shown as providing 46% to meet water demands and San Patricio MWD as providing 54% to meet water demands through 2070.

7. TWDB historical use records (2010-2015) show 1,213 acft is provided by reuse for Nueces County-manufacturing.

8. For Year 2020, no surplus exists as treated supply is equal to demand, which is less than WTP average annual capacity.

9. Water supply delivered from the City to SPMWD is 38,084 acft/yr raw water + 15,592 acft/yr treated water in Year 2020 (53,486 acft/yr total). An amendment to the raw water contract was approved by Corpus Christi City Council on August 20, 2019 to total 46,800 acft/yr raw water to SPMWD after Year 2020. An amendment between the City of Corpus Christi and SPMWD increases the treated water contract to 27,000 acft after Year 2020, with an additional provision for 10,000 acft/yr reserve with advance notice (up to 37,000 acft/yr treated water). These two contract amendments results in a total 73,800 acft/yr contracted supply after Year 2020.

10. SPMWD has a potable (municipal) water treatment plant with 19 MGD design capacity and industrial water treatment plant capacity of 15.8 MGD. Average day municipal treatment capacity is calculated at 12.9 MGD, or 14,457 acft/yr, after considering a peaking capacity of 1.47:1. Average day industrial treatment capacity is calculated at 11.7 MGD with a peaking capacity of 1.35:1 (15.8 MGD/1.35 = 11.7 MGD), or 13,072 acft/yr. Peak to average day ratios were based on actual 2018 customer water use.

11. For Year 2020, assumes 33% of the San Patricio County Manufacturing demand is fulfilled by raw water and remaining 67% from treated water. From Year 2030 onward, assumes 25% of the San Patricio County Manufacturing demand is supplied by raw water and 75% from treated water. Assumes 448 acft/yr reuse water supply for industries based on TWDB historical reuse in San Patricio County.

12. Shortage to meet SPMWD needs. Assumes raw water delivered to District treatment plants equal to demands, or District treatment capacity whichever is the lesser of the two.

13. Of the total water demand for NCWCID 4 (Port Aransas), the City is shown as providing 46% to meet water demands and San Patricio MWD as providing 54% to meet water demands through 2070.

14. With additional raw water supplies developed by the City of Corpus Christi to meet contract with SPMWD, SPWMD shows surplus ranging from 15,336 to 15,678 acft/yr during the entire 2020-2070 period based on demands.

The City of Corpus Christi, after meeting demands and/or contracts with its customers, has raw water supply shortages from 2030 through 2070, showing a need for increased source water supplies. In addition, beginning in 2030, the City has shortages associated with the treated water customers, indicating that the current treatment plant capacity is not sufficient to meet future treated water needs. Shortages are shown for municipal, industrial, and agricultural users in Nueces County, as seen in Table 4A.20. SPMWD is authorized to receive 53,486 ac-ft/yr of water from the City of Corpus Christi in 2020 and 73,800 ac-ft/yr after 2020, which would meet the demands of its customers and have a raw water surplus throughout the planning period. However, the City does not currently have the supply to provide the full contracted purchases after 2020, and therefore SPMWD shows increasing water supply shortages from 2030 through 2070. With additional raw water supplies developed by the City of Corpus Christi to meet contract with SPMWD, SPMWD shows a surplus ranging from 15,336 to 15,678 ac-ft/yr during the entire 2020-2070 planning period. SPMWD's shortages are applied to San Patricio County manufacturing. Mining and irrigation also have shortages in San Patricio as shown in Table 4A.22. STWA receives treated water supplies to meet the demands of its customers, consistent with the terms of the present contracts, and has no projected shortages. Nueces County WCID #3 receives supply through run-of-river water rights and is projected to have a shortage in all decades attributed to a lack of sufficient firm yield during drought of record conditions.

4A.5 Secondary Needs Analysis

A secondary water needs analysis was performed for all WUGs and MWPs, representing the water needs that would remain assuming full implementation of water conservation or direct reuse recommended water management strategies. Secondary needs (i.e. second-tier needs) were calculated by TWDB for WUGs based on State Water Planning Database (DB22) entries and is included in Appendix A. Using this information, a secondary needs analysis was summarized for MWPs as shown in Table 4A.25.

Table 4A.25.
Coastal Bend Region Major Water Provider (MWP) Secondary Water Needs

Major Water Provider	Second Tier Needs (ac-ft/yr)					
	2020	2030	2040	2050	2060	2070
City of Corpus Christi	—	(9,292)	(8,139)	(11,625)	(15,723)	(19,576)
San Patricio Municipal Water District	—	(1,641)	(3,908)	(6,386)	(8,869)	(11,615)
South Texas Water Authority	—	—	—	—	—	—
Nueces County WCID 3	(4,046)	(3,730)	(3,392)	(3,083)	(2,805)	(2,552)

Note: Dashes shown when no water needs are identified.

4A.6 Region Summary

When comparing total available supplies to total demands, the region shows a shortage throughout the 50-year planning cycle. Beginning in 2020 a shortage of 13,530 ac-ft exists within the Region and increases to a shortage of 49,363 ac-ft by 2070 (Table 4A.26 and Figure 4A.2). A small portion of this shortage is associated with treatment plant capacity constraints and is not necessarily a raw water shortage (for example, see Table 4A.24). Current O.N. Stevens WTP improvements are in progress to increase treatment plant capacity, which should be sufficient to address long term water needs with recommended water management strategies for additional supplies.

Municipal and Industrial Summary

On a regional basis, Municipal and Industrial entities (Manufacturing, Steam-Electric, and Mining) show a shortage increasing from 12,247 ac-ft in 2020 to 47,889 ac-ft in 2070, due primarily to decreasing manufacturing surface water availability accompanied by increasing manufacturing demand beginning in 2030. Shortages in supplies provided by the CCR/LCC/Texana/MRP Phase II System were placed on industrial (mining and/or manufacturing) demands in San Patricio and Nueces Counties consistent with the approach used for all previous water planning cycles.

Municipal demands account for approximately 48 percent of total demands in the region in 2070. Surface water accounts for approximately 85 percent of 2070 municipal supplies, with groundwater accounting for 15 percent. Overall, the Coastal Bend Region is experiencing a municipal water supply shortage throughout the 50-year planning cycle. The specific municipal entities experiencing shortages are summarized in Table 4A.27.

Manufacturing demands account for 36 percent of total demands in 2070. The majority of these demands, 99 percent, are in Nueces and San Patricio Counties. Jim Wells, Kleberg, and Live Oak Counties make up the remaining 1 percent. Surface water supplies provide 94 percent of total manufacturing supplies in 2070; groundwater 6 percent. Region-wide there is a manufacturing supply deficit of 16,434 ac-ft in 2030 increasing to 34,441 ac-ft by 2070.

Jim Wells, Kleberg, Live Oak, Nueces, and San Patricio Counties show manufacturing shortages beginning between 2020 and 2030. Manufacturing shortages are summarized in Table 4A.28.

As for the remaining industrial demands, there are sufficient surface water supplies to meet all Region N projected steam-electric water demands of 3,996 ac-ft through 2070.

The regional mining demand, 5,497 ac-ft, accounts for only 2 percent of total demand in 2070. Multiple counties show immediate and long-term shortages from 2020 to 2070, summarized in Table 4A.29.

Table 4A.26. Coastal Bend Region Summary Population, Water Supply, and Water Demand Projections

	Population Projection	2020	2030	2040	2050	2060	2070
		614,790	661,815	692,982	714,508	731,481	744,544
	Supply and Demand by Type of Use	Year					
		2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Municipal	Municipal Demand	115,366	121,198	124,655	127,324	130,021	132,248
	Municipal Existing Supply						
	Groundwater	15,641	16,034	16,436	16,919	17,158	17,538
	Surface water	89,491	94,594	97,451	99,475	101,758	103,478
	Total Existing Municipal Supply	105,132	110,628	113,887	116,394	118,916	121,016
	Municipal Balance	(10,234)	(10,570)	(10,768)	(10,930)	(11,105)	(11,232)
Industrial	Manufacturing Demand	88,634	98,480	98,480	98,480	98,480	98,480
	Manufacturing Existing Supply	0					
	Groundwater	3,874	3,930	3,930	3,930	3,930	3,930
	Surface water	84,950	78,116	73,041	68,809	64,326	60,109
	Total Manufacturing Supply	88,824	82,046	76,971	72,739	68,256	64,039
	Manufacturing Balance	190	(16,434)	(21,509)	(25,741)	(30,224)	(34,441)
	Steam-Electric Demand	3,996	3,996	3,996	3,996	3,996	3,996
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	3,996	3,996	3,996	3,996	3,996	3,996
	Total Steam-Electric Supply	3,996	3,996	3,996	3,996	3,996	3,996
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	8,951	9,821	9,660	7,206	6,157	5,497
	Mining Existing Supply						
	Groundwater	6,748	7,391	7,333	5,021	3,999	3,281
	Surface water	0	0	0	0	0	0
	Total Mining Supply	6,748	7,391	7,333	5,021	3,999	3,281
	Mining Balance	(2,203)	(2,430)	(2,327)	(2,185)	(2,158)	(2,216)
Agriculture	Irrigation Demand	30,206	30,206	30,206	30,206	30,206	30,206
	Irrigation Existing Supply						
	Groundwater	28,732	28,732	28,732	28,732	28,732	28,732
	Surface water	191	0	0	0	0	0
	Total Irrigation Supply	28,923	28,732	28,732	28,732	28,732	28,732
	Irrigation Balance	(1,283)	(1,474)	(1,474)	(1,474)	(1,474)	(1,474)
	Livestock Demand	6,065	6,065	6,065	6,065	6,065	6,065
	Livestock Existing Supply						
	Groundwater	4,990	4,990	4,974	4,974	4,974	4,974
	Surface water	1,075	1,075	1,091	1,091	1,091	1,091
	Total Livestock Supply	6,065	6,065	6,065	6,065	6,065	6,065
	Livestock Balance	0	0	0	0	0	0
Total	Municipal and Industrial Demand	216,947	233,495	236,791	237,006	238,654	240,221
	Existing Municipal and Industrial Supply						
	Groundwater	26,263	27,355	27,699	25,870	25,087	24,749
	Surface water	178,437	176,706	174,488	172,281	170,080	167,583
	Total Municipal and Industrial Supply	204,700	204,061	202,187	198,151	195,167	192,332
	Municipal and Industrial Balance	(12,247)	(29,434)	(34,604)	(38,855)	(43,487)	(47,889)
	Agriculture Demand	36,271	36,271	36,271	36,271	36,271	36,271
	Existing Agricultural Supply						
	Groundwater	33,722	33,722	33,706	33,706	33,706	33,706
	Surface water	1,266	1,075	1,091	1,091	1,091	1,091
	Total Agriculture Supply	34,988	34,797	34,797	34,797	34,797	34,797
	Agriculture Balance	(1,283)	(1,474)	(1,474)	(1,474)	(1,474)	(1,474)
	Total Demand	253,218	269,766	273,062	273,277	274,925	276,492
	Total Supply						
	Groundwater	59,985	61,077	61,405	59,576	58,793	58,455
	Surface water	179,703	177,781	175,579	173,372	171,171	168,674
	Total Supply	239,688	238,858	236,984	232,948	229,964	227,129
	Total Balance	(13,530)	(30,908)	(36,078)	(40,329)	(44,961)	(49,363)

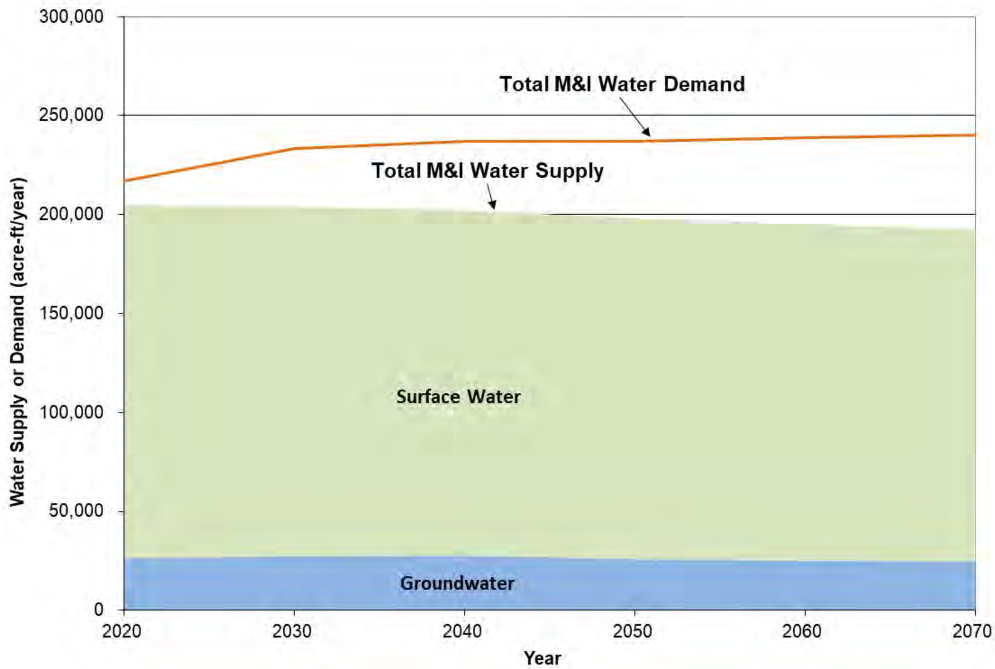


Figure 4A.2.
Municipal and Industrial Supply and Demand

Table 4A.27.
Municipal Entities with Projected Water Shortages

County/City	Projected Shortages (ac-ft)		
	2020	**2040**	**2070**
Bee County			
El Oso WSC	(94)	(94)	(90)
TDCJ Chase Field	(177)	(208)	(203)
County-Other	(1,657)	(1,675)	(1,654)
Brooks County			
County-Other	(192)	(237)	(309)
Duval County			
San Diego MUD	(288)	(338)	(417)
County-Other	(477)	(490)	(516)
Jim Wells County			
County Other	(2,058)	(2,266)	(2,650)
Nueces County			
Nueces County WCID 3	(3,812)	(3,760)	(3,736)
River Acres WSC	(234)	(270)	(293)
County-Other	(1,245)	(1,430)	(1,364)

Table 4A.28.
Manufacturing with Projected Water Shortages

County	Projected Shortages (ac-ft)		
	2020	2040	2070
Jim Wells County	—	(16)	(16)
Kleberg County	—	(247)	(247)
Live Oak County	—	(28)	(28)
Nueces County	—	(11,685)	(16,587)
San Patricio County	—	(9,533)	(17,563)

Table 4A.29.
Mining with Projected Water Shortages

County	Projected Shortages (ac-ft)		
	2020	2040	2070
Bee County	(197)	(158)	(62)
Brooks County	(179)	(162)	(120)
Duval County	(712)	(676)	(428)
Jim Wells County	(52)	(36)	(1)
Kenedy County	(58)	(32)	—
Kleberg County	(139)	(122)	(80)
Nueces County	(629)	(836)	(1,127)
San Patricio County	(237)	(305)	(398)

Agriculture Summary

Irrigation demand remains constant at 30,206 ac-ft over the 50-year planning period and in 2070 represents 11 percent of total demand. Groundwater accounts for almost 100 percent of the total projected irrigation water supply. Irrigation shortages are summarized in Table 4A.30.

Table 4A.30.
Irrigation with Projected Water Shortages

County/City	Projected Shortages (ac-ft)		
	2020	2040	2070
Bee County	(352)	(352)	(352)
Jim Wells County	(333)	(333)	(333)
Live Oak County	(343)	(534)	(534)
Nueces County	(51)	(51)	(51)
San Patricio County	(204)	(204)	(204)

Livestock demand remains constant at 6,065 ac-ft over the 50-year planning period and in 2070 represents 2 percent of total demand. For each county, groundwater was allocated based on maximum historic use from 2010 to 2015. Surface water supplies were assumed to consist of local, on-farm sources and used to meet demands.

Summary

Overall, the Coastal Bend Region has insufficient supplies to meet the demands of the six WUG categories through 2070. Water groups with shortages are presented in Figure 4A.3.

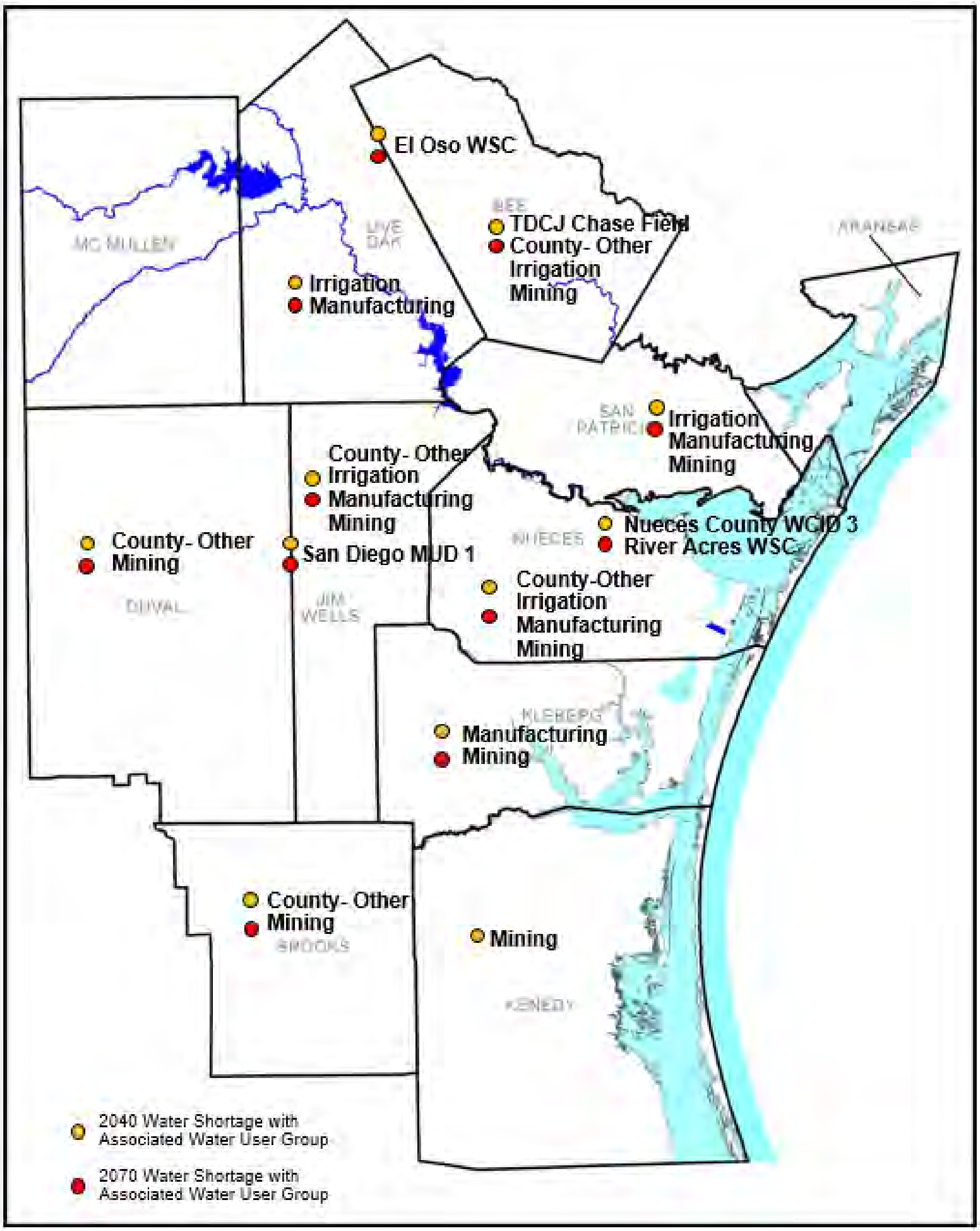
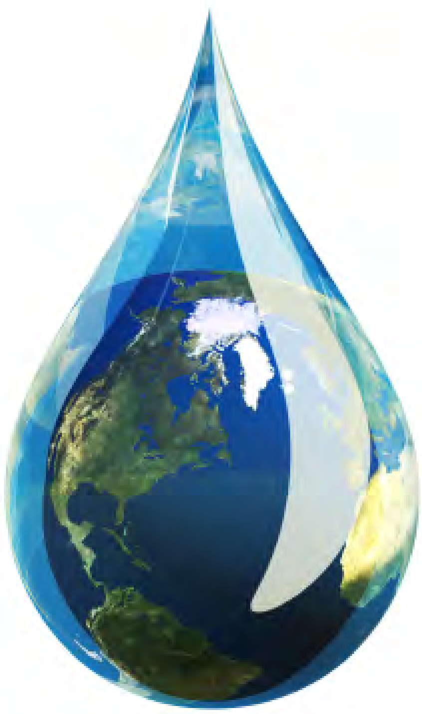


Figure 4A.3.
Location and Type of Use for 2040 and 2070 Water Supply Shortages



5

Water Management Strategies

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Chapter 5: Water Management Strategies

5A.1 Identification of Potentially Feasible Water Management Strategies

The CBRWPG identified and evaluated potentially feasible water management strategies for each water user group and wholesale water provider in the region, particularly for those water user groups with shortages projected during the planning period. As required by Texas Water Code, the Coastal Bend Regional Water Planning group considered the following potential feasible water management strategies for inclusion in the 2021 Plan:

- Conservation
- Aquifer Storage and Recovery
- Desalination
- Reuse
- Management of Existing Supplies
- Conjunctive Use
- Acquisition of Available Existing Water Supplies
- Development of New Water Supplies
- Development of Regional Water Supply Projects or Facilities
- Voluntary Transfer of Water Within the Region
- Emergency Transfers of Water

The CBRWPG considered a complete list of potentially feasible water management strategies based on previous plans, local on-going studies, and feedback from local sponsors as summarized in Figure 5.A.1.1 and Chapter 11. These potentially feasible strategies included all water management strategy types referenced in the Texas Water Code as presented above. On May 10, 2018, the CBRWPG removed non-relevant strategies no longer actively considered by local sponsors and developed a list of potentially feasible water management strategies for evaluation in the 2021 Plan. Water management strategies from previous plans considered no longer relevant for active evaluation in the 2021 Plan were summarized and are included in Chapter 11.3. Subsequent to adoption of a list of water management strategies at the August 9, 2018 CBRWPG meeting, three additional water management strategies for a total of four projects were approved by the CBRWPG between May and November 2019 for addition to the list of water management strategies to evaluate in the 2021 Plan.

A total of 11 water management strategies were investigated during the development of the Coastal Bend Regional Water Plan. Many of these strategies include several water supply options within the main strategy. These strategies are summarized in Table 5A.1.1. The potentially feasible water management strategies selected by the CBRWPG for the 2021 Plan are based on those identified in the 2016 Plan, in addition to new projects identified by Wholesale Water Providers and other water user groups. Local studies since the 2016 Plan assisted in the selection process of potentially feasible water management strategies.

Identification of Potentially Feasible Water Management Strategies For Development of the 2021 Coastal Bend Regional Water Plan (adopted August 10, 2017)

The process of identifying potentially feasible water management strategies outlined below was followed for the development of the 2021 Coastal Bend Regional Water Plan (2021 Plan)[1]:

1) The Coastal Bend Regional Water Planning Group (RWPG) recognizes that regional water planning is an evolving process and draws upon results obtained from previous planning cycles. A summary of water management strategies from the 2001, 2006, 2011, 2016 Plans was considered at the August 10, 2017 RWPG meeting for consideration for the 2021 Plan. The Texas Water Code list of water management strategies eligible for consideration in the Plan was also discussed.
2) Current local, on-going studies and future water plans, including specific water management strategies of interest, was solicited from Wholesale Water Providers and Water User Groups for development of a list of potentially feasible water management strategies for the 2021 Plan.
3) Considering information provided by water providers, a draft list of potentially feasible water management strategies was prepared and discussed at the May 10, 2018 Coastal Bend RWPG meeting for public comment. The Coastal Bend RWPG formed a scope of subcommittee to review potentially feasible strategies.
4) The scope of work subcommittee convened on June 27, 2018 to review a draft list of potentially feasible water management strategies and prepared a recommendation for Coastal Bend RWPG consideration considering TWDB funding allocations for water management strategy evaluations. The scope of work subcommittee directed the technical consultant to prepare a scope of work based on water management strategies identified.
5) The scope of work was considered and adopted at the August 9, 2018 Coastal Bend RWPG after receiving public comment. Subsequently, the Nueces River Authority submitted a letter request for TWDB consideration and approval.
6) Follow-up coordination with Wholesale Water Providers to confirm list of water management strategies for development of the 2021 Plan. The wholesale water providers were encouraged to classify each water management strategy on their draft list as recommended, alternative, or rejected (where applicable).
7) The scope of work submitted by the 2021 Coastal Bend RWPG was approved by the TWDB and identified water management strategies to be evaluated.
8) The list of potentially feasible water management strategies was included in the Technical Memorandum submitted to the TWDB in September 2018.
9) Additional water management strategies were considered and approved for evaluation and inclusion in the 2021 Region N at the May 9, September 19, and November 14, 2019 Coastal Bend RWPG meetings, at WUG sponsor request and expense. These strategies were added to the list of potentially feasible water management strategies approved by the Coastal Bend RWPG in September 2018 and are presented in the Initially Prepared Plan for the 2021 Plan.

[1] Pursuant to Texas Administrative Code Title 31 Part 10 Chapter 357.5(e)(4) of the Regional Water Planning Guidelines which states: "Before a regional water planning group begins the process of identifying potentially feasible water management strategies, it shall document the process by which it will list all possible water management strategies and identify the water management strategies that are potentially feasible for meeting a need in the region."

Figure 5.A.1.1.
Region N-Adopted Process for Identification of Potentially Feasible Water Management Strategies for Development of the 2021 Coastal Bend Regional Water Plan

Table 5A.1.1.
Potentially Feasible Water Management Strategies Selected by the CBRWPG for Evaluation in the 2021 Plan

N-1	Municipal Water Conservation
N-2	Irrigation Water Conservation
N-3	Manufacturing Water Conservation
N-4	Mining Water Conservation
N-5	Reuse
N-6	Local Balancing Storage Reservoir
N-7	City of Corpus Christi Aquifer Storage and Recovery
N-8	Gulf Coast Aquifer Supplies
N-9	Groundwater Desalination
N-10	Seawater Desalination
N-11	Regional Water Treatment Plant Facility Expansions and Improvements

All potentially feasible water management strategy evaluations in the 2021 Plan included in Chapter 5D were evaluated in accordance with 31 Texas Administrative Code 357.34 requirements and TWDB guidelines. Water management strategies from previous plans that were identified as relevant by the CBRWPG for the 2021 Plan were updated to reflect new costs, redeveloped to meet current rule requirements, revised for changed physical or socioeconomic conditions, and/or updated to reflect current project configuration information based on the level of detail requested by project sponsors or Coastal Bend Regional Water Planning group members. Water losses associated with recommended WMS are anticipated to be negligible with routine, standard maintenance performed to extend project life. In accordance with TWDB guidance, water plans should not include project costs associated with maintenance of replacing existing infrastructure.

At their regular public meeting on August 10, 2017, the Coastal Bend Regional Water Planning Group approved their process for identifying and evaluating potentially feasible water management strategies for the Coastal Bend Region, which is provided in Figure 5.A.1.1.

5B.1 Water Management Strategy Evaluations and Recommended Water Management Strategies

Table 5B.1.1 summarizes strategies that were selected for inclusion as recommended or alternative strategies in the plan for Wholesale Water Providers in Region N and Table 5B.1.2 shows potential strategies for other local service areas. The Plan does not include any retail distribution-level infrastructure or associated costs, except those associated with municipal water conservation-related strategies such as pipeline and meter replacement programs. Strategies related to water treatment plant improvements (5D.11) rely on development of new raw water supplies to fully deliver at treated capacity. Without new raw water supplies, the treated water available with these strategies declines as existing raw water supplies become utilized by industrial customers to meet growing water demands. There are no Region N strategies that mutually exclude another recommended strategy.

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Table 5B.1.1.
Potential Water Management Strategies to Meet Long-Term Needs for Wholesale Water Providers

WMS ID	Water Management Strategy	Additional Water Supply (ac-ft/yr)	Total Project Cost ($)	Annual Cost ($)	Unit Cost of Additional Treated Water ($ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5D.1	**Municipal Water Conservation**	up to 18,793	Variable, Regional Cost up to $94,234,000	Variable	$498 - $503	No change	Possible reduction in return flows to bay and estuary
5D.3	**Manufacturing Water Conservation**	up to 14,733	Highly variable	Highly variable	Variable	Variable. Depends on BMP. Low to significant improvement.	Possible reduction in return flows to bay and estuary
5D.5	**Reuse**						
	Regional Industrial Wastewater Reuse Plan (6.47 MGD)	7,250	$137,834,000	$10,046,000	$1,386	Improves quality	Potential reduction of freshwater inflows to bay and estuary; construction and maintenance of pipeline corridors
	Regional Industrial Wastewater Reuse Plan (4.47 MGD)	5,010	$115,502,000	$8,475,000	$1,692	Improves quality	
5D.6	**Local Balancing Storage Reservoir**	4,058	$21,575,000	$1,641,000	$426	No Change	Construction and maintenance of pipeline corridors and terminal storage
5D.7	**City of Corpus Christi Aquifer Storage and Recovery**						
	Phase I (13 MGD)	14,573	$68,632,000 to $90,199,000	$6,979,000 to $8,836,000	$479 to $606	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
	Phase II (18 MGD)	20,178	$123,253,000 to $174,668,000	$12,189,000 to $16,383,000	$604 to $812	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
5D.8	**Gulf Coast Aquifer Supplies**						
	Evangeline/Laguna Groundwater Project (Raw)						
	Delivery Option 1- MAG constrained	24,873	$115,585,000	$22,210,000	$893	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 1- Future	28,486	$115,585,000	$24,446,000	$858	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 2- MAG constrained	24,873	$74,596,000	$18,492,000	$743	Slight degradation	Construction and maintenance of pipeline corridors
	Delivery Option 3- MAG constrained	24,873	$78,063,000	$19,119,000	$769	Slight degradation	Construction and maintenance of pipeline corridors
5D.9	**Groundwater Desalination**						
	Evangeline/Laguna Groundwater Project (Treated)						
	Delivery Option 1- MAG constrained	19,898	$190,416,000	$37,675,000	$1,893	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Delivery Option 1- Future	22,788	$190,416,000	$39,776,000	$1,745	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Delivery Option 2- MAG constrained	19,898	$155,431,000	$34,707,000	$1,744	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Delivery Option 3- MAG constrained	19,898	$157,550,000	$35,159,000	$1,767	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5D.10	**Seawater Desalination**						
	City of Corpus Christi- Inner Harbor (10 MGD)	11,201	$236,693,000	$36,042,000	$3,218	Variable. Low to significant improvement.	Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
	City of Corpus Christi- Inner Harbor (30 MGD)	33,604	$562,779,000	$85,875,000	$2,555	Variable. Low to significant improvement.	
	City of Corpus Christi- La Quinta (20 MGD)	22,402	$420,372,000	$62,720,000	$2,800	Variable. Low to significant improvement.	

WMS ID	Water Management Strategy	Additional Water Supply (ac-ft/yr)	Total Project Cost ($)	Annual Cost ($)	Unit Cost of Additional Treated Water ($ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
	City of Corpus Christi- La Quinta (40 MGD)	44,804	$768,475,000	$114,102,000	$2,547	Variable. Low to significant improvement.	
	Poseidon Regional Seawater Desalination Project at Ingleside (50 MGD)	56,044	$724,984,000	$123,638,000	$2,206	Variable. Low to significant improvement.	
	Poseidon Regional Seawater Desalination Project at Ingleside (100 MGD)	112,000	$1,280,848,000	$218,932,000	$1,955	Variable. Low to significant improvement.	
	Port of Corpus Christi Authority- Harbor Island (50 MGD)	56,044	$802,807,000	$130,167,000	$2,323	Variable. Low to significant improvement.	Threatened and endangered species habitat identified near project site. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	33,604	$457,732,000	$77,991,000	$2,321	Variable. Low to significant improvement.	Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
5D.11	**Regional Water Treatment Plant Facility Expansions- ON Stevens WTP**	32,030	$68,212,000	$6,266,000	$565	No Change	None

Table 5B.1.2.
Potential Water Management Strategies to Meet Long-Term Needs for Local Service Areas

WMS ID	Water Management Strategy	Water Supply (ac-ft/yr)	Total Project Cost ($)	Annual Cost ($)	Unit Cost of Treated Water ($ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5D.1	**Municipal Water Conservation**	**up to 18,793**	**Variable, Regional Cost up to $94,234,000**	**Variable**	**$498 - $503**	**No change**	**Possible reduction in return flows to bay and estuary**
5D.2	**Irrigation Water Conservation**	**430**	**Variable, Regional Cost up to $12,111,317**		**$1,911 - $4,822**	**No change**	**None**
5D.3	**Manufacturing Water Conservation**	**up to 14,733**	**Highly variable**	**Highly variable**	**Variable**	**Variable. Depends on BMP. Low to significant improvement.**	**Possible reduction in return flows to bay and estuary**
5D.4	**Mining Water Conservation**	**up to 374**	**Highly variable**	**Highly variable**	**Variable**	**No change**	**Possible reduction in return flows to bay and estuary**
5D.5	**Reuse**						
	City of Alice- Non-potable Reuse	897	$10,222,000	$1,300,000	$1,449	Improves quality	Reduction of freshwater inflows to intermittent, local streams. Possible reduction in return flows to bay and estuary; construction and maintenance of pipeline corridors
5D.8	**Gulf Coast Aquifer Supplies**						
	Bee County-Other (Municipal)	1,682	$4,943,000	$551,000	$328	No to low degradation	Minor Impacts
	El Oso WSC	94	$424,000	$52,000	$553	No to low degradation	Minor Impacts
	Bee County- Irrigation	352	$1,166,000	$97,000	$276	No to low degradation	Minor Impacts
	Bee County- Mining	197	$622,000	$51,000	$259	No to low degradation	Minor Impacts
	TDCJ Chase Field	208	$703,000	$84,000	$404	No to low degradation	Minor Impacts
	Brooks County-Other (Municipal)	309	$1,207,000	$133,000	$430	No to low degradation	Minor Impacts
	Brooks County- Mining	182	$615,000	$53,000	$291	No to low degradation	Minor Impacts
	Duval County-Other (Municipal)	516	$2,109,000	$228,000	$442	No to low degradation	Minor Impacts
	Duval County- Mining	768	$3,228,000	$274,000	$357	No to low degradation	Minor Impacts
	Duval County- San Diego MUD 1	417	$1,856,000	$189,000	$453	No to low degradation	Minor Impacts
	Jim Wells County-Other (Municipal)	2,650	$10,704,000	$1,039,000	$392	No to low degradation	Minor Impacts
	Jim Wells County- Irrigation	333	$753,000	$61,000	$183	No to low degradation	Minor Impacts
	Jim Wells County- Manufacturing	16	$129,000	$11,000	$688	No to low degradation	Minor Impacts
	Jim Wells County- Mining	55	$202,000	$17,000	$309	No to low degradation	Minor Impacts
	Kenedy County- Mining	63	$469,000	$37,000	$587	No to low degradation	Minor Impacts
	Kleberg County- Manufacturing	247	$852,000	$68,000	$275	No to low degradation	Minor Impacts
	Kleberg County- Mining	142	$638,000	$51,000	$359	No to low degradation	Minor Impacts
	Live Oak County- Irrigation	534	$917,000	$76,000	$142	No to low degradation	Minor Impacts
	Live Oak County- Manufacturing	28	$188,000	$14,000	$500	No to low degradation	Minor Impacts
	Nueces County- Other (Municipal)	1,435	$4,514,000	$462,000	$322	No to low degradation	Minor Impacts
	Nueces County- Irrigation	51	$319,000	$24,000	$471	No to low degradation	Minor Impacts
	Nueces County-Mining	1,127	$2,200,000	$178,000	$158	No to low degradation	Minor Impacts
	San Patricio County- Irrigation	204	$420,000	$33,000	$162	No to low degradation	Minor Impacts
	San Patricio County- Mining	398	$1,141,000	$91,000	$229	No to low degradation	Minor Impacts
5D.9	**Groundwater Desalination**						
	City of Alice- Brackish Groundwater Desalination	3,360	$23,983,000	$3,932,000	$1,170	Variable. Low to significant improvement.	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.

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All strategies are compared with respect to four areas of interest: 1) additional water supply; 2) unit cost of treated water; 3) degree of water quality improvement; and 4) environmental issues and special concerns. A graphical comparison of how each significant strategy compares to the others with respect to unit cost and water supply quantity is shown in Figure 5.B.1.1. A detailed analysis of each strategy is included in Section 5D (refer to Chapters 5D.1 through 5D.11). In these detailed descriptions, each strategy was evaluated with respect to eleven impact categories, as required by TWDB rules. These categories are shown in Table 5B.1.3. An evaluation summary is included at the end of each water management strategy description, which summarizes how each strategy relates to the ten impact categories.

Each strategy includes a separate Environmental Issues discussion, which describes environmental factors including impacts to agricultural resources. In the evaluation summaries, some impacts are qualitatively discussed. According to TAC Chapter 357.34(e)(3), quantitative reporting is required for quantity (yield), cost, environmental factors, and impacts to agricultural resources. Table 5B.1.4 and Table 5B.1.5 include the keys to the environmental issues and impacts to agricultural resources descriptors, respectively, presented in the evaluation summaries.

Recommended plans to meet the specific needs of the cities and other WUGs during the planning period (2020 through 2070) are presented in the following sections. The plans are organized by county and WUG in the following sections (Chapters 5B.2 to 5B.13). Annual and unit costs are shown for each water management strategy and decline after debt service is paid, which generally occurs after 20 years. A new balance is shown in each water supply plan calculated after recommended water management strategy yields have been applied to shortages. Water supply plans for WUGs and MWPs frequently include multiple recommended water management strategies that when totaled, sum up to more than the volume needed to meet a water supply shortage. This additional supply accounts for uncertainties in population projections, future demands, climate variability, yield of recommended water management strategies, permitting challenges, and other uncertainties. The TWDB-provided table that shows the calculated management supply factors for each decade by WUG is included in Appendix A. Using this information, management supply factors were summarized for MWP and is presented in Table 5B.1.6.

According to the TWDB, regional planning is a reconnaissance-level effort and a detailed investigation of project impacts is beyond the scope and mandate of this effort. The impacts, costs, and benefit of large-scale projects such as reservoirs or major diversions would, if implemented, undergo additional and extensive evaluation during permitting under Section 404 of the Clean Water Act, the National Environmental Protection Action, and any other applicable federal, state, or local regulations.

Water conservation is recommended based on per capita rates, described below in Section 5C.Drought Management is not a recommended water management strategy to meet projected water needs in the Coastal Bend Region, in part because it cannot be demonstrated to be an economically feasible strategy. However, a safe yield reserve of 75,000 ac-ft is included as a drought management measure when evaluating regional surface water supplies from the CCR/LCC/Texana/MRP Phase II system as discussed in Chapter 7.

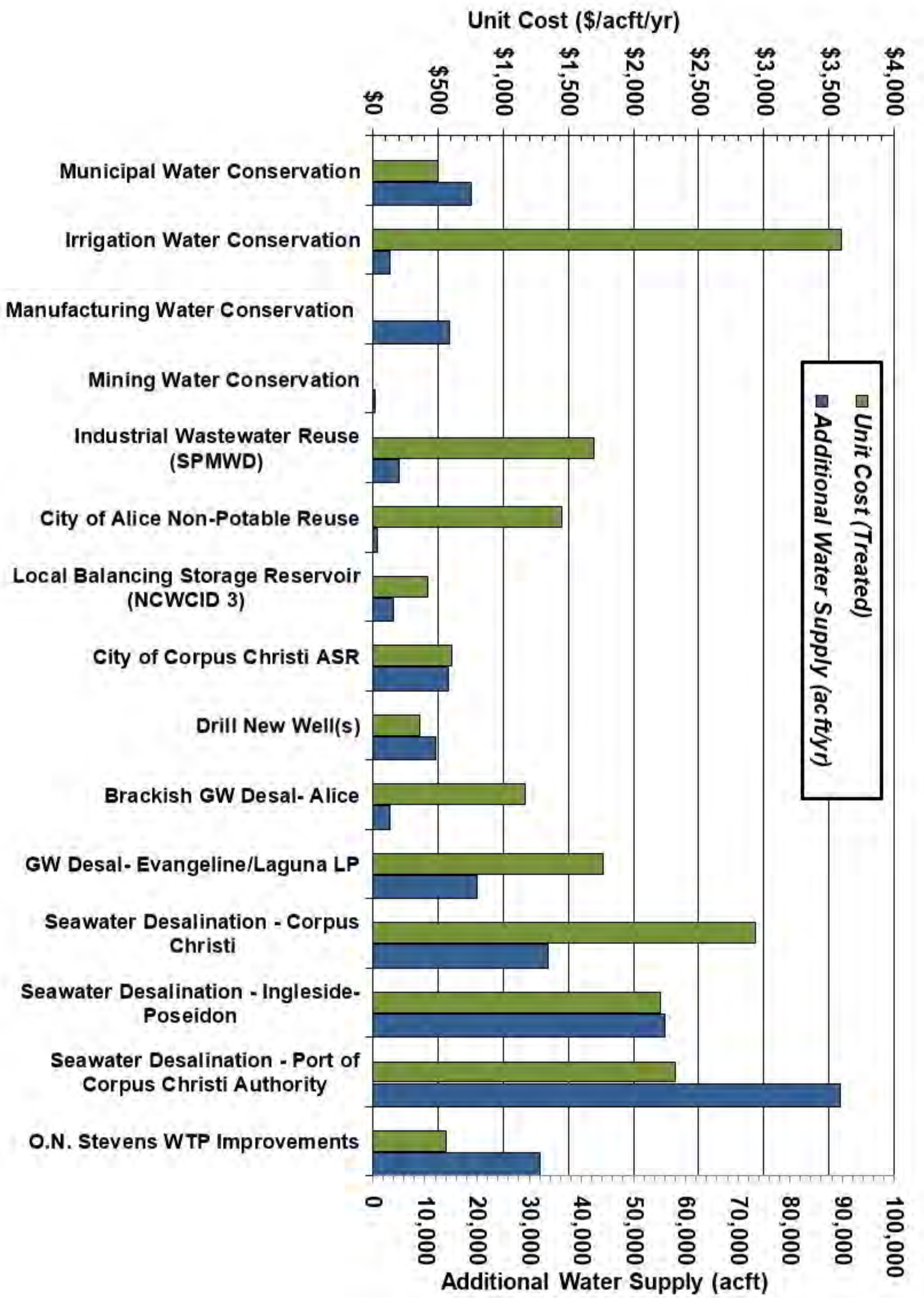

Figure 5.B.1.1.
Unit Cost and Water Supply Comparison for Selected Water Management Strategies

Table 5B.1.3.
Summary of Impact Categories for Evaluation of Water Management Strategies

a. Water Supply
1. Quantity
2. Reliability
3. Cost of Treated Water
b. Environmental factors
1. Instream flows
2. Bay and Estuary Inflows and arms of the Gulf of Mexico
3. Wildlife Habitat
4. Wetlands
5. Threatened and Endangered Species
6. Cultural Resources
7. Water Quality (Key Parameters Identified by Region N) a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents
c. Impacts to agricultural resources and State water resources
d. Threats to agriculture and natural resources in region
e. Recreational impacts
f. Equitable comparison of strategies
g. Interbasin transfers
h. Third party social and economic impacts from voluntary redistribution of water
i. Efficient use of existing water supplies and regional opportunities
j. Effect on navigation
k. Impacts on water pipelines and other facilities currently used for water conveyance

Table 5B.1.4. *Impacts to Environmental Factors Key*

Impacts to Environmental Factors Key	Criteria
None or Low; Negligible	Reduction in environmental flows with implementation of the strategy is indiscernible (less than 1%) using the approved surface water availability model, as compared to instream, Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Wildlife habitat is not expected to be altered by the project. Wetlands are not expected to be altered (less than 1% alteration) with project implementation. Threatened and endangered species habitat are not expected to be altered (less than 1% alteration) with project implementation. Cultural resources are not expected to be altered with project implementation. .
Moderate; Some	Reduction in environmental flows with implementation of the strategy is expected to range from 1% to 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Due to the nature of the strategy, localized impacts to small creeks or on-site tanks may be noticed (up to 10%). Wildlife habitat may be temporarily impacted during project construction (less than 10% area), but long-term impacts to wildlife habitat are not expected. Wetlands may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Threatened and endangered species habitat may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Cultural resources are not expected to be altered with project implementation.
High	Reduction in environmental flows with implementation of the strategy is expected to exceed 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Long-term wildlife habitat alteration (of 10% or greater) is highly likely with project. Permanent wetlands (of 20% or more current wetland area) is highly likely with project implementation. Threatened and endangered species habitat is highly likely (20% or more of habitat area) with project implementation. Cultural resources are highly likely to be altered with project implementation. .

Table 5B.1.5. *Impacts to Agricultural Resources Key*

Impacts to Agricultural Resources Key	Criteria
None or Low; Negligible	Temporary impacts to agricultural land during project construction. Occasion disturbances due to maintenance on right of way for pipelines. Less than 5 irrigated acres permanently affected due to repurposing of land to support the project.
Moderate; Some	Loss of up to 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).
High	Loss of more than 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).

Table 5B.1.6.
Region N Major Water Providers Management Supply Factor

Major Water Provider	MWP Management Supply Factor					
	2020	2030	2040	2050	2060	2070
City of Corpus Christi	1.1	1.6	1.7	1.7	1.7	1.7
San Patricio Municipal Water District	1.3	3.9	3.8	3.8	3.8	3.8
South Texas Water Authority	1.0	1.0	1.0	1.0	1.0	1.0
Nueces County WCID 3	1.0	1.1	1.2	1.2	1.3	1.3

The TWDB socioeconomic impact analysis of water needs in Coastal Bend Region was provided for the Region N Plan. As part of the analysis, the TWDB developed costs to represent impacts of leaving water needs entirely unmet for each water use category and as an aggregate for the region under a repeat of the drought of record. The TWDB's socioeconomic impact analysis represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. The TWDB's analysis for Region N is included in Appendix B.

The estimated effect of projected water shortages upon annual income in the region, are $732 million in 2020, $3.2 billion in 2040, and $6.9 billion in 2070. If the water needs are left entirely unmet, the level of shortage in 2020 results in approximately 6,000 fewer jobs than would be expected if the water needs of 2020 are fully met. The gap in job growth due to water shortages grows to around 22,200 fewer jobs by 2040 and 48,000 fewer jobs by 2070.

Future projects involving authorization from either the TCEQ and/or TWDB which are not specifically addressed in the plan are considered to be consistent with the plan under the following circumstances:

1. TWDB receives applications for financial assistance for many types of water supply projects, including water conservation, and when appropriate, wastewater reuse strategies. Other projects involve repairing, replacing, or expanding treatment plants, pump stations, pipelines and water storage facilities. The RWPG considers projects that do not involve the development of or connection to a new water source to be consistent with the regional water plan even though not specifically recommended in the plan.

2. TCEQ considers water rights applications for various types of uses (e.g., recreation, navigation, irrigation, hydroelectric power, industrial, recharge, municipal and others). Many of these applications are for small amounts of water, some are temporary, and some are even non-consumptive. Because waters of the Nueces River Basin are fully appropriated to the City of Corpus Christi and others, any new water rights application for consumptive water use from this Basin will need to protect the existing water rights or provide appropriate mitigation to existing water right owners. Throughout the Coastal Bend Region the types of small projects that may arise are so unpredictable that the RWPG is of the opinion that each project should be considered by the TWDB and TCEQ

on their merits, and that the Legislature foresaw this situation and provided appropriate language for each agency to deal with it.

(Note: The provision related to TCEQ is found in Texas Water Code §11.134. It provides that the Commission shall grant an application to appropriate surface water, including amendments, only if the proposed appropriator addresses a water supply need in a manner consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant. For TWDB funding, Texas Water Code §16.053(j) states that after January 5, 2002 TWDB may provide financial assistance to a water supply project only after the Board determines that the needs to be addressed by the project will be addressed in a manner that is consistent with that appropriate regional water plan. The TWDB may waive this provision if conditions warrant.)

5B.2 Aransas County Water Supply Plan

Table 5B.2.1 lists each water user group in Aransas County and their corresponding surplus or shortage in years 2040 and 2070. For each WUG, a water supply plan is presented in the following subsections. There are no projected shortages for Aransas County water user groups.

Table 5B.2.1.
Aransas County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2040 (ac-ft/yr)	Surplus/(Shortage)[1] 2070 (ac-ft/yr)	Comment
City of Aransas Pass	0	0	Supply equals demand
City of Rockport	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	none	none	No demands projected
Livestock	0	0	Supply equals demand

[1] From Tables 4A.2 and 4A.3, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.2.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties.

5B.2.3 City of Rockport

The City of Rockport has a contract with the SPMWD to purchase treated water. The contract allows the City of Rockport to purchase only the water that it needs. No shortages in annual water supplies are projected for the City of Rockport; however, additional water conservation is a recommended water management strategy for the City (Table 5B.2.2).

Table 5B.2.2.
Recommended Water Supply Plan for the City of Rockport

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	270	353	327	321	321
New Balance	**0**	**270**	**353**	**327**	**321**	**321**

Estimated costs of the recommended plan for the City of Rockport are shown in Table 5B.2.3.

Table 5B.2.3.
Recommended Plan Costs by Decade for the City of Rockport

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$134,659	$176,002	$162,940	$159,796	$159,796
Unit Cost ($/ac-ft)*	$498	$498	$498	$498	$498	$498

* Unit costs for this plan element are rounded.

5B.2.4 County-Other

County-Other in Aransas County obtains water from the SPMWD and a small amount from the Gulf Coast Aquifer (~10% demand). No shortages in annual water supplies are projected for Aransas County-Other and no changes in water supply are recommended.

5B.2.5 Manufacturing

No manufacturing demand exists or is projected for the county.

5B.2.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.2.7 Mining

The mining water demands in Aransas County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining users and no changes in water supply are recommended.

5B.2.8 Irrigation

No irrigation demand exists or is projected for the county.

5B.2.9 Livestock

The livestock water demands in Aransas County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.3 Bee County Water Supply Plan

Table 5B.3.1 lists each water user group in Bee County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.3.1.
Bee County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Beeville	0	0	Supply equals demand
El Oso WSC	(94)	(90)	Projected shortage – see Live Oak County plan
Pettus MUD	0	0	Supply equals demand
TDCJ Chase Field	(208)	(203)	Projected shortage – see plan below
County-Other	(1,675)	(1,654)	Projected shortage – see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	(158)	(62)	Projected shortage – see plan below
Irrigation	(352)	(352)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A.4 and 4A.5, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.3.1 City of Beeville

The City of Beeville obtains water from contracts with the City of Corpus Christi to purchase raw water from the CCR/LCC System water supply and from the Gulf Coast Aquifer. The contract with the City allows the City of Beeville to purchase only the water that it needs. No shortages are projected for the City of Beeville; however, additional water conservation is a recommended water management strategy for the City (Table 5B.3.2).

Table 5B.3.2.
Recommended Water Supply Plan for the City of Beeville

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	254	502	757	806	806
New Balance	**0**	**254**	**502**	**757**	**806**	**806**

Estimated costs of the recommended plan for the City of Beeville are shown in Table 5B.3.3.

Table 5B.3.3.
Recommended Plan Costs by Decade for the City of Beeville

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$126,376	$249,879	$377,062	$401,140	$401,169
Unit Cost ($/ac-ft)*	$498	$498	$498	$498	$498	$498

* Unit costs for this plan element are rounded.

5B.3.2 El Oso WSC

El Oso WSC is located in Bee and Live Oak Counties, with the majority of demand located in Live Oak County. See Live Oak County for the El Oso WSC plan.

5B.3.3 Pettus MUD

Pettus MUD demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for Pettus MUD and no changes in water supply are recommended.

5B.3.4 TDCJ Chase Field

TDCJ Chase Field obtains water supply from the Gulf Coast Aquifer. Shortages are projected for the entity beginning in 2020 and continuing through 2070. The following water management strategies are recommended for TDCJ Chase Field (Table 5B.3.4).

Table 5B.3.4.
Recommended Water Supply Plan for TDCJ Chase Field

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(177)	(203)	(208)	(204)	(203)	(203)
Recommended Plan						
Municipal Water Conservation	0	85	167	247	322	391
Drill New Well	208	208	208	208	208	208
Total New Supply	**208**	**293**	**375**	**455**	**530**	**599**
New Balance	**31**	**90**	**167**	**251**	**327**	**396**

Estimated costs of the recommended plan for County-Other entities are shown in Table 5B.3.5.

Table 5B.3.5.
Recommended Plan Costs by Decade for TDCJ Chase Field

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$42,623	$83,544	$123,331	$160,986	$195,701
Unit Cost ($/ac-ft)*	$500	$500	$500	$500	$500	$500
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$84,000	$84,000	$35,000	$35,000	$35,000	$35,000
Unit Cost ($/ac-ft)*	$404	$404	$168	$168	$168	$168

* Unit costs for this plan element are rounded.

5B.3.5 County-Other

Bee County-Other entities obtain water supply from the Gulf Coast Aquifer. Shortages are projected beginning in 2020 and continuing through 2070. The following water management strategies are recommended for County-Other entities (Table 5B.3.6).

Table 5B.3.6.
Recommended Water Supply Plan for Bee County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(1,657)	(1,682)	(1,675)	(1,656)	(1,654)	(1,654)
Recommended Plan						
Drill New Well	1,682	1,682	1,682	1,682	1,682	1,682
Total New Supply	**1,682**	**1,682**	**1,682**	**1,682**	**1,682**	**1,682**
New Balance	**25**	**0**	**7**	**26**	**28**	**28**

Estimated costs of the recommended plan for County-Other entities are shown in Table 5B.3.7.

Table 5B.3.7.
Recommended Plan Costs by Decade for Bee County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$551,000	$551,000	$203,000	$203,000	$203,000	$203,000
Unit Cost ($/ac-ft)*	$328	$328	$121	$121	$121	$121

* Unit costs for this plan element are rounded.

5B.3.4 Manufacturing

No manufacturing demand exists or is projected for the county.

5B.3.5 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.3.6 Mining

Mining supply in Bee County is obtained through groundwater from the Gulf Coast Aquifer. Shortages are projected for mining throughout the planning period. The following water management strategies are recommended for mining entities in Bee County (Table 5B.3.8).

Table 5B.3.8.
Recommended Water Supply Plan for Bee County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(197)	(185)	(158)	(109)	(79)	(62)
Recommended Plan						
Mining Water Conservation	10	20	28	33	37	42
Drill New Well	197	197	197	197	197	197
Total New Supply	**207**	**217**	**225**	**230**	**234**	**239**
New Balance	**10**	**32**	**67**	**121**	**155**	**177**

Estimated costs of the recommended plan for mining entities are shown in Table 5B.3.9.

Table 5B.3.9.
Recommended Plan Costs by Decade for Bee County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$51,000	$51,000	$7,000	$7,000	$7,000	$7,000
Unit Cost ($/ac-ft)*	$259	$259	$36	$36	$36	$36

* Unit costs for this plan element are rounded. ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.3.7 Irrigation

Irrigation supply in Bee County is obtained through groundwater from the Gulf Coast Aquifer. Shortages are projected for irrigation users throughout the planning period. The following water management strategies are recommended for irrigation users in Bee County (Table 5B.3.10).

Table 5B.3.10.
Recommended Water Supply Plan for Bee County Irrigation

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(352)	(352)	(352)	(352)	(352)	(352)
Recommended Plan						
Irrigation Water Conservation	105	210	315	421	526	631
Drill New Well	352	352	352	352	352	352
Total New Supply	**457**	**562**	**667**	**773**	**878**	**983**
New Balance	**105**	**210**	**315**	**421**	**526**	**631**

Estimated costs of the recommended plan for irrigation users are shown in Table 5B.3.11.

Table 5B.3.11.
Recommended Plan Costs by Decade for Bee County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Irrigation Water Conservation (Chapter 5D.2)						
Annual Cost ($/yr)	$506,951	$1,013,901	$1,520,852	$2,027,803	$2,534,754	$3,041,704
Unit Cost ($/ac-ft)*	$4,822	$4,822	$4,822	$4,822	$4,822	$4,822
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$97,000	$97,000	$15,000	$15,000	$15,000	$15,000
Unit Cost ($/ac-ft)*	$276	$276	$43	$43	$43	$43

* Unit costs for this plan element are rounded.

5B.3.8 Livestock

The livestock water demands in Bee County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for livestock and no changes in water supply are recommended.

5B.4 Brooks County Water Supply Plan

Table 5B.4.1 lists each water user group in Brooks County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.4.1.
Brooks County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Falfurrias	0	0	Supply equals demand
County-Other	(237)	(309)	Projected shortage – see plan below
Manufacturing	0	0	Supply equals demand
Steam-Electric	none	none	No demands projected
Mining	(162)	(120)	Projected shortage – see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A.6 and 4A.7, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.4.1 City of Falfurrias

The City of Falfurrias receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the City of Falfurrias; however, additional water conservation is a recommended water management strategy (Table 5B.4.2).

Table 5B.4.2.
Recommended Water Supply Plan for the City of Falfurrias

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	132	266	406	546	688
New Balance	**0**	**132**	**266**	**406**	**546**	**688**

Estimated costs of the recommended plan for the City of Falfurrias are shown in Table 5B.4.3.

Table 5B.4.3.
Recommended Plan Costs by Decade for the City of Falfurrias

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$65,765	$132,887	$203,058	$273,171	$344,021
Unit Cost ($/ac-ft)*	$500	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.4.2 County-Other

The Brooks County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Brooks County-Other throughout the planning period. The following water management strategy is recommended (Table 5B.4.4).

Table 5B.4.4.
Recommended Water Supply Plan for Brooks County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(192)	(214)	(237)	(265)	(292)	(309)
Recommended Plan						
Drill New Well	309	309	309	309	309	309
Total New Supply	**309**	**309**	**309**	**309**	**309**	**309**
New Balance	**117**	**95**	**72**	**44**	**17**	**0**

Estimated costs of the recommended plan for County-Other users are shown in Table 5B.4.5.

Table 5B.4.5.
Recommended Plan Costs by Decade for Brooks County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$133,000	$133,000	$48,000	$48,000	$48,000	$48,000
Unit Cost ($/ac-ft)*	$430	$430	$155	$155	$155	$155

* Unit costs for this plan element are rounded.

5B.4.3 Manufacturing

The manufacturing water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for manufacturing users and no changes in water supply are recommended.

5B.4.4 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.4.5 Mining

Brooks County mining users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for mining users throughout the planning period. The following water management strategies are recommended (Table 5B.4.6).

Table 5B.4.6.
Recommended Water Supply Plan for Brooks County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(179)	(182)	(162)	(146)	(130)	(120)
Recommended Plan						
Mining Water Conservation	9	18	26	32	39	45
Drill New Well	182	182	182	182	182	182
Total New Supply	**191**	**200**	**208**	**214**	**221**	**227**
New Balance	**12**	**18**	**46**	**68**	**91**	**107**

Estimated costs of the recommended plan for irrigation users are shown in Table 5B.4.7.

Table 5B.4.7.
Recommended Plan Costs by Decade for Brooks County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$53,000	$53,000	$10,000	$10,000	$10,000	$10,000
Unit Cost ($/ac-ft)*	$291	$291	$55	$55	$55	$55

* Unit costs for this plan element are rounded. ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.4.6 Irrigation

The irrigation water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5B.4.7 Livestock

The livestock water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.5 Duval County Water Supply Plan

Table 5B.5.1 lists each water user group in Duval County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.5.1.
Duval County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Duval County CRD	0	0	Supply equals demand
Freer WCID	0	0	Supply equals demand
San Diego MUD 1	(338)	(417)	Projected shortage – see plan below
County-Other	(490)	(516)	Projected shortage – see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	(676)	(428)	Projected shortage – see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A.8 and 4A.9, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.5.1 Duval County CRD

Duval County CRD receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Duval County CRD and no changes in water supply are recommended.

5B.5.2 Freer WCID

Freer WCID receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Freer WCID; however, additional water conservation is a recommended water management strategy for the WCID (Table 5B.5.2). See Section 5C for more details.

Table 5B.5.2.
Recommended Water Supply Plan for Freer WCID

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	54	110	170	211	215
New Balance	**0**	**54**	**110**	**170**	**211**	**215**

Estimated costs of the recommended plan for Freer WCID are shown in Table 5B.5.3.

Table 5B.5.3.
Recommended Plan Costs by Decade for Freer WCID

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$26,957	$55,153	$84,895	$105,332	$107,588
Unit Cost ($/ac-ft)*	$500	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.5.3 San Diego MUD 1

San Diego MUD 1 is located in Duval and Jim Well Counties; however, its water supply plan is presented here. The City of San Diego obtains groundwater supplies from the Goliad Sands of the Gulf Coast Aquifer.

Shortages are projected for San Diego MUD 1. The recommended water supply management plan for the MUD is shown in Table 5B.5.4. There are sufficient Gulf Coast Aquifer supplies to drill an additional well without exceeding MAG constraints.

Table 5B.5.4.
Recommended Water Supply Plan for San Diego MUD 1

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(288)	(315)	(338)	(365)	(392)	(417)
Recommended Plan						
Municipal Water Conservation	0	68	108	102	103	107
Gulf Coast Aquifer Supplies	417	417	417	417	417	417
Total New Supply	**417**	**485**	**525**	**519**	**520**	**554**
New Balance	**129**	**170**	**187**	**154**	**128**	**107**

Estimated costs of the recommended plan for San Diego MUD 1 are shown in Table 5B.5.5.

Table 5B.5.5.
Recommended Plan Costs by Decade for San Diego MUD 1

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$33,803	$54,129	$51,183	$51,530	$53,309
Unit Cost ($/ac-ft)*	$500	$500	$500	$500	$500	$500
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$189,000	$189,000	$58,000	$58,000	$58,000	$58,000
Unit Cost ($/ac-ft)	$453	$453	$139	$139	$139	$139

* Unit costs for this plan element are rounded.

The City of Alice has run a 16-inch water transmission line to Hwy 281 bypass, approximately 8 to 9 miles from the City of San Diego. This pipeline could be extended to provide water supply from the City of Alice to San Diego. Although this is not a recommended strategy, it could provide an alternative supply to the City of San Diego.

5B.5.4 County-Other

Shortages are projected for Duval County-Other municipal users beginning in 2020. The recommended water supply management plan for County-Other is shown in Table 5B.5.6. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5B.5.6.
Recommended Water Supply Plan for Duval County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(477)	(484)	(490)	(497)	(508)	(516)
Recommended Plan						
Gulf Coast Aquifer Supplies	516	516	516	516	516	516
Total New Supply	**516**	**516**	**516**	**516**	**516**	**516**
New Balance	**39**	**32**	**26**	**19**	**8**	**0**

Estimated costs of the recommended plan for Duval County-Other are shown in Table 5B.5.7.

Table 5B.5.7.
Recommended Plan Costs by Decade for Duval County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$228,000	$228,000	$80,000	$80,000	$80,000	$80,000
Unit Cost ($/ac-ft)	$442	$442	$155	$155	$155	$155

* Unit costs for this plan element are rounded.

5B.5.5 Manufacturing

No manufacturing demand exists or is projected for the county.

5B.5.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.5.7 Mining

Duval County-Other mining users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Duval County mining users beginning in 2020. The recommended water supply management plan for mining users is shown in Table 5B.5.8. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5B.5.8.
Recommended Water Supply Plan for Duval County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(712)	(768)	(676)	(565)	(489)	(428)
Recommended Plan						
Mining Water Conservation	35	72	101	124	146	166
Gulf Coast Aquifer Supplies	768	768	768	768	768	768
Total New Supply	**803**	**840**	**869**	**892**	**914**	**934**
New Balance	**91**	**72**	**193**	**327**	**425**	**506**

Estimated costs of the recommended plan for Duval County Mining are shown in Table 5B.5.9.

Table 5B.5.9.
Recommended Plan Costs by Decade for Duval County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$274,000	$274,000	$47,000	$47,000	$47,000	$47,000
Unit Cost ($/ac-ft)*	$357	$357	$61	$61	$61	$61

* Unit costs for this plan element are rounded.
ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.5.8 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5B.5.9 Livestock

The livestock water demands in Duval County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.6 Jim Wells County Water Supply Plan

Table 5B.6.1 lists each water user group in Jim Wells County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.6.1.
Jim Wells County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Alice	0	0	Supply equals demand
Jim Wells County FWSD 1	0	0	Supply equals demand
City of Orange Grove	0	0	Supply equals demand
City of Premont	0	0	Supply equals demand
San Diego MUD 1			See Duval County
County-Other	(2,266)	(2,650)	Projected shortage – see plan below
Manufacturing	(16)	(16)	Projected shortage – see plan below
Steam-Electric	none	none	No demands projected
Mining	(36)	(1)	Projected shortage – see plan below
Irrigation	(333)	(333)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

1 From Tables 4A.10 and 4A.11, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.6.1 City of Alice

The City of Alice has a contract to purchase water from the City of Corpus Christi via Lake Corpus Christi. The City also maintains a small reservoir in town, Lake Findley, which serves as temporary storage of waters from Lake Corpus Christi. This reservoir is fed naturally by a small watershed and has no effective firm yield. No shortages are projected for the City of Alice; however, the following water management strategies are recommended for the City (Table 5B.6.2).

Table 5B.6.2.
Recommended Water Supply Plan for the City of Alice

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	345	725	899	938	981
Brackish Groundwater Desalination	3,360	3,360	3,360	3,360	3,360	3,360
Reuse – Non-Potable	–	897	897	897	897	897
New Balance	**3,360**	**4,602**	**4,982**	**5,156**	**5,195**	**5,238**

Estimated costs of the recommended plan for the City of Alice are shown in Table 5B.6.3.

Table 5B.6.3.
Recommended Plan Costs by Decade for the City of Alice

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$171,844	$361,080	$447,512	$467,259	$488,694
Unit Cost ($/ac-ft)*	–	$498	$498	$498	$498	$498
Brackish Groundwater Desalination (Chapter 5D.9)						
Annual Cost ($/yr)	$3,932,000	$3,932,000	$2,245,000	$2,245,000	$2,245,000	$2,245,000
Unit Cost ($/ac-ft)	$1,170	$1,170	$668	$668	$668	$668
Reuse – Non-Potable (Chapter 5D.5)						
Annual Cost ($/yr)	–	$1,300,000	$1,300,000	$581,000	$581,000	$581,000
Unit Cost ($/ac-ft)	–	$1,449	$1,449	$648	$648	$648

* Unit costs for this plan element are rounded.

5B.6.2 City of Orange Grove

The City of Orange Grove's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Orange Grove; however, additional water conservation is a recommended water management strategy for the City (Table 5B.6.4).

Table 5B.6.4.
Recommended Water Supply Plan for the City of Orange Grove

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	40	83	131	181	232
New Balance	**0**	**40**	**83**	**131**	**181**	**232**

Estimated costs of the recommended plan for the City of Orange Grove are shown in Table 5B.6.5.

Table 5B.6.5.
Recommended Plan Costs by Decade for the City of Orange Grove

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$19,957	$41,730	$65,573	$90,448	$115,863
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.6.3 City of Premont

The City of Premont's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Premont; however, additional water conservation is a recommended water management strategy for the City (Table 5B.6.6).

Table 5B.6.6.
Recommended Water Supply Plan for the City of Premont

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	58	120	194	268	302
New Balance	**0**	**58**	**120**	**194**	**268**	**302**

Estimated costs of the recommended plan for the City of Premont are shown in Table 5B.6.7.

Table 5B.6.7.
Recommended Plan Costs by Decade for the City of Premont

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$28,963	$60,021	$96,825	$134,128	$151,144
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.6.4 City of San Diego

The City of San Diego is in both Duval and Jim Wells Counties. See Duval County for the City's water management plan.

5B.6.5 County-Other

Jim Wells County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Jim Wells County-Other beginning in 2020. The recommended water supply management plan for County-Other municipal users is shown in Table 5B.6.8. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5B.6.8.
Recommended Water Supply Plan for Jim Wells County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(2,058)	(2,164)	(2,266)	(2,395)	(2,525)	(2,650)
Recommended Plan						
Gulf Coast Aquifer Supplies	2,650	2,650	2,650	2,650	2,650	2,650
New Balance	**592**	**486**	**384**	**255**	**125**	**0**

Estimated costs of the recommended plan for Jim Wells County-Other are shown in Table 5B.6.9.

Table 5B.6.9.
Recommended Plan Costs by Decade for Jim Wells County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$1,039,000	$1,039,000	$286,000	$286,000	$286,000	$286,000
Unit Cost ($/ac-ft)*	$392	$392	$108	$108	$108	$108

* Unit costs for this plan element are rounded.

5B.6.6 Manufacturing

Jim Wells manufacturing users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for manufacturing entities beginning in 2020. The recommended water supply management plan for Jim Wells manufacturing is shown in Table 5B.6.10. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5B.6.10.
Recommended Water Supply Plan for Jim Wells County Manufacturing

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	(16)	(16)	(16)	(16)	(16)
Recommended Plan						
Manufacturing Water Conservation	2	5	7	10	12	14
Gulf Coast Aquifer Supplies	–	16	16	16	16	16
Total New Supply	**2**	**21**	**23**	**26**	**28**	**30**
New Balance	**2**	**5**	**7**	**10**	**12**	**14**

Estimated costs of the recommended plan for Jim Wells County Manufacturing are shown in Table 5B.6.11.

Table 5B.6.11.
Recommended Plan Costs by Decade for Jim Wells County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Manufacturing Water Conservation (Chapter 5D.3)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$11,000	$11,000	$2,000	$2,000	$2,000	$2,000
Unit Cost ($/ac-ft)*	$688	$688	$125	$125	$125	$125

* Unit costs for this plan element are rounded.
ND = Not Determined due to high variability in costs associated with manufacturing BMPs.

5B.6.7 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.6.8 Mining

Mining users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for mining beginning in 2020. The recommended water supply management plan is shown in Table 5B.6.12.

Table 5B.6.12.
Recommended Water Supply Plan for Jim Wells County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(52)	(55)	(36)	(21)	(7)	(1)
Recommended Plan						
Mining Water Conservation	2	4	4	4	3	3
Gulf Coast Aquifer Supplies	55	55	55	55	55	55
Total New Supply	**57**	**59**	**59**	**59**	**58**	**58**
New Balance	**5**	**4**	**23**	**38**	**51**	**57**

Estimated costs of the recommended plan for Jim Wells County Mining are shown in TTable 5B.6.13.

Table 5B.6.13.
Recommended Plan Costs by Decade for Jim Wells County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$17,000	$17,000	$3,000	$3,000	$3,000	$3,000
Unit Cost ($/ac-ft)*	$309	$309	$55	$55	$55	$55

* Unit costs for this plan element are rounded.
ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.6.9 Irrigation

Irrigation users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for irrigation beginning in 2020. The recommended water supply management plan is shown in Table 5B.6.14.

Table 5B.6.14.
Recommended Water Supply Plan for Jim Wells County Irrigation

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(333)	(333)	(333)	(333)	(333)	(333)
Recommended Plan						
Irrigation Water Conservation	48	96	143	191	239	287
Gulf Coast Aquifer Supplies	333	333	333	333	333	333
Total New Supply	**381**	**429**	**476**	**524**	**572**	**620**
New Balance	**48**	**96**	**143**	**191**	**239**	**287**

Estimated costs of the recommended plan for Jim Wells County Irrigation are shown in Table 5B.6.15.

Table 5B.6.15.
Recommended Plan Costs by Decade for Jim Wells County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Irrigation Water Conservation (Chapter 5D.2)						
Annual Cost ($/yr)	$91,412	$182,824	$274,236	$365,648	$457,059	$548,471
Unit Cost ($/ac-ft)*	$1,911	$1,911	$1,911	$1,911	$1,911	$1,911
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$61,000	$61,000	$8,000	$8,000	$8,000	$8,000
Unit Cost ($/ac-ft)	$183	$183	$24	$24	$24	$24

* Unit costs for this plan element are rounded.

5B.6.10 Livestock

The livestock water demands in Jim Wells County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.7 Kenedy County Water Supply Plan

Table 5B.7.1 lists each water user group in Kenedy County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.7.1.
Kenedy County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	(32)	0	Projected shortage – see plan below
Irrigation	none	none	No demands projected
Livestock	0	0	Supply equals demand

[1] From Tables 4A.12 and 4A.13, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.7.1 County-Other

The Kenedy County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Kenedy County-Other entities; however, additional water conservation is a recommended water management strategy for the entity (Table 5B.7.2).

Table 5B.7.2.
Recommended Water Supply Plan for Kenedy County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	23	45	65	84	101
New Balance	**0**	**23**	**45**	**65**	**84**	**101**

Estimated costs of the recommended plan for Kenedy County-Other are shown in Table 5B.7.3.

Table 5B.7.3.
Recommended Plan Costs by Decade for Kenedy County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$11,325	$22,379	$32,681	$41,953	$50,515
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.7.2 Manufacturing

No manufacturing demand exists or is projected for the county.

5B.7.3 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.7.4 Mining

Kenedy County mining users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for mining from 2020 through 2050. The recommended water supply management plan is shown in Table 5B.7.4.

Table 5B.7.4.
Recommended Water Supply Plan for Kenedy County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(58)	(63)	(32)	(8)	0	0
Recommended Plan						
Mining Water Conservation	3	6	7	7	5	4
Drill New Well	63	63	63	63	63	63
Total New Supply	**66**	**69**	**70**	**70**	**68**	**67**
New Balance	**8**	**6**	**38**	**62**	**68**	**67**

Estimated costs of the recommended plan for Kenedy County Mining are shown in Table 5B.7.5.

Table 5B.7.5.
Recommended Plan Costs by Decade for Kenedy County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$37,000	$37,000	$4,000	$4,000	$4,000	$4,000
Unit Cost ($/ac-ft)*	$587	$587	$63	$63	$63	$63

* Unit costs for this plan element are rounded.
ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.7.5 Irrigation

No irrigation demand exists or is projected for the county.

5B.7.6 Livestock

The livestock water demands in Kenedy County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.8 Kleberg County Water Supply Plan

Table 5B.8.1 lists each water user group in Kleberg County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.8.1.
Kleberg County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
Baffin Bay WSC	0	0	Supply equals demand
City of Kingsville	0	0	Supply equals demand
Naval Air Station Kingsville	0	0	Supply equals demand
Ricardo WSC	0	0	Supply equals demand
Riviera Water System	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	(247)	(247)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	(122)	(80)	Projected shortage – see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A.14 and 4A.15, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.8.1 Baffin Bay WSC

Baffin Bay WSC's water supply is from the Gulf Coast Aquifer. No shortages are projected for the WSC and no changes in water supply are recommended.

5B.8.2 City of Kingsville

The City of Kingsville has a contract with the South Texas Water Authority (STWA) to purchase treated surface water from the CCR/LCC/Texana/MRP Phase II System. The City also has five wells with a combined capacity of 3.7 mgd (or 4,130 ac-ft/yr) that pump groundwater from the Gulf Coast Aquifer. No shortages are projected for Kingsville and no changes in water supply are recommended.

5B.8.3 Naval Air Station Kingsville

The Naval Air Station in Kingsville obtains water supply from the Gulf Coast Aquifer. No shortages are projected for the air station; however, additional water conservation is a recommended water management strategy (Table 5B.8.2).

Table 5B.8.2.
Recommended Water Supply Plan for Naval Air Station Kingsville

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	26	54	84	114	144
New Balance	**0**	**26**	**54**	**84**	**114**	**144**

Estimated costs of the recommended plan for the Naval Air Station in Kingsville are shown in Table 5B.8.3.

Table 5B.8.3.
Recommended Plan Costs by Decade for Naval Air Station Kingsville

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$13,134	$27,055	$42,022	$57,175	$71,953
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.8.4 Ricardo WSC

STWA provides water to the Ricardo Water Supply Corporation via a direct 12” transmission line that became operational in December 2013. Ricardo WSC demands are met with surface water supplies. No shortages are projected for Ricardo WSC and no changes in water supply are recommended.

5B.8.5 Riviera Water System

The Riviera Water System obtains groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the water system and no changes in water supply are recommended.

5B.8.6 County-Other

Kleberg County-Other receives groundwater supplies from the Gulf Coast Aquifer and some surface water supplies from nearby water providers, including the City of Kingsville. No shortages are projected for the Kleberg County-Other; however, additional water conservation is a recommended water management strategy for this entity (Table 5B.8.4).

Table 5B.8.4.
Recommended Water Supply Plan for Kleberg County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	10	6	6	6	6
New Balance	**0**	**10**	**6**	**6**	**6**	**6**

Estimated costs of the recommended plan for Kleberg County-Other are shown in Table 5B.8.5.

Table 5B.8.5.
Recommended Plan Costs by Decade for Kleberg County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$5,134	$3,078	$2,836	$2,956	$2,860
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.8.7 Manufacturing

Kleberg County manufacturing use, identified by the TWDB, is supplied by groundwater from the Gulf Coast Aquifer. Shortages are projected for manufacturing users beginning in 2030. The recommended water supply management plan is shown in Table 5B.8.6.

Table 5B.8.6.
Recommended Water Supply Plan for Kleberg County Manufacturing

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	(247)	(247)	(247)	(247)	(247)
Recommended Plan						
Manufacturing Water Conservation	45	103	154	206	257	308
Gulf Coast Aquifer Supplies	–	247	247	247	247	247
Total New Supply	**45**	**350**	**401**	**453**	**504**	**555**
New Balance	**45**	**103**	**154**	**206**	**257**	**308**

Estimated costs of the recommended plan for Kleberg County Manufacturing are shown in Table 5B.8.7.

Table 5B.8.7.
Recommended Water Supply Plan for Kleberg County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Manufacturing Water Conservation (Chapter 5D.3)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	–	$68,000	$68,000	$8,000	$8,000	$8,000
Unit Cost ($/ac-ft)*	–	$275	$275	$32	$32	$32

* Unit costs for this plan element are rounded.

ND = Not Determined due to high variability in costs associated with manufacturing BMPs.

5B.8.8 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.8.9 Mining

Mining water demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer. Shortages are projected for mining throughout the planning period. The recommended water supply management plan is shown in Table 5B.8.8.

Table 5B.8.8.
Recommended Water Supply Plan for Kleberg County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(139)	(142)	(122)	(106)	(90)	(80)
Recommended Plan						
Mining Water Conservation	9	18	26	32	39	45
Gulf Coast Aquifer Supplies	142	142	142	142	142	142
Total New Supply	**151**	**160**	**168**	**174**	**181**	**187**
New Balance	**12**	**18**	**46**	**68**	**91**	**107**

Estimated costs of the recommended plan for Kleberg County Mining are shown in Table 5B.8.9.

Table 5B.8.9.
Recommended Water Supply Plan for Kleberg County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$51,000	$51,000	$6,000	$6,000	$6,000	$6,000
Unit Cost ($/ac-ft)	$359	$359	$42	$42	$42	$42

* Unit costs for this plan element are rounded.
ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.8.10 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5B.8.11 Livestock

The livestock demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.9 Live Oak County Water Supply Plan

Table 5B.9.1 lists each water user group in Live Oak County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.9.1. Live Oak County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
El Oso WSC	(94)	(90)	Projected shortage – see plan below
City of George West	0	0	Supply equals demand
McCoy WSC	0	0	Supply equals demand
City of Three Rivers	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	(28)	(28)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	0	0	Supply equals demand
Irrigation	(534)	(534)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A.16 and 4A.17, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.9.1 El Oso WSC

El Oso Water Supply Corporation is located in both Bee and Live Oak Counties, with the majority of demand located in Live Oak County. The El Oso Water Supply Corporation receives groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for El Oso WSC in Bee County throughout the planning period. The recommended water supply management plan is shown in Table 5B.9.2; the projected shortages and supplies are for the entire WSC across both Bee and Live Oak counties.

Table 5B.9.2. Recommended Water Supply Plan for El Oso WSC

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(94)	(94)	(94)	(94)	(90)	(90)
Recommended Plan						
Municipal Water Conservation	0	20	40	60	49	49
Gulf Coast Aquifer Supplies	94	94	94	94	94	94
Total New Supply	**94**	**114**	**134**	**154**	**143**	**143**
New Balance	**0**	**20**	**40**	**60**	**53**	**53**

Estimated costs of the recommended plan for El Oso WSC are shown in Table 5B.9.3.

***Table 5B.9.3.
Recommended Water Supply Plan for El Oso WSC***

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$9,838	$19,838	$29,785	$24,499	$24,499
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$52,000	$52,000	$22,000	$22,000	$22,000	$22,000
Unit Cost ($/ac-ft)*	$553	$553	$234	234	234	234

* Unit costs for this plan element are rounded.

5B.9.2 City of George West

The City of George West's demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for George West; however, additional water conservation is a recommended water management strategy for the City (Table 5B.9.4).

***Table 5B.9.4.
Recommended Water Supply Plan for the City of George West***

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	30	42	39	38	38
New Balance	**0**	**30**	**42**	**39**	**38**	**38**

Estimated costs of the recommended plan for the City of George West are shown in Table 5B.9.5.

***Table 5B.9.5.
Recommended Plan Costs by Decade for the City of George West***

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$15,214	$20,776	$19,276	$18,776	$18,776
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.9.3 McCoy WSC

McCoy WSC's demands are met with groundwater from the Carrizo-Wilcox Aquifer. No shortages are projected for McCoy WSC and no changes in water supply are recommended.

5B.9.4 City of Three Rivers

The City of Three Rivers' demands are met with stored water from Choke Canyon Reservoir through contract with the City of Corpus Christi. No shortages are projected for Three Rivers; however, additional water conservation is a recommended water management strategy for the City (Table 5B.9.6).

Table 5B.9.6.
Recommended Water Supply Plan for the City of Three Rivers

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	37	24	18	17	17
New Balance	**0**	**37**	**24**	**18**	**17**	**17**

Estimated costs of the recommended plan for the City of Three Rivers are shown in Table 5B.9.7.

Table 5B.9.7.
Recommended Plan Costs by Decade for the City of Three Rivers

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$18,399	$12,165	$9,165	$8,665	$8,665
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.9.5 County-Other

Live Oak County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Live Oak County-Other and no changes in water supply are recommended.

5B.9.6 Manufacturing

Live Oak County manufacturing users receive groundwater supplies from the Gulf Coast Aquifer and surface water supplies from run-of-river rights in the Nueces Basin. Shortages are projected for Live Oak Manufacturing beginning in 2030. The recommended water supply management plan is shown in Table 5B.9.8.

Table 5B.9.8.
Recommended Water Supply Plan for Live Oak County Manufacturing

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	(28)	(28)	(28)	(28)	(28)
Recommended Plan						
Manufacturing Water Conservation	57	125	187	249	312	374
Gulf Coast Aquifer Supplies	28	28	28	28	28	28
Total New Supply	**85**	**153**	**215**	**277**	**340**	**402**
New Balance	**85**	**125**	**187**	**249**	**312**	**374**

Estimated costs of the recommended plan for Live Oak County Manufacturing are shown in Table 5B.9.9.

Table 5B.9.9.
Recommended Water Supply Plan for Live Oak County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Manufacturing Water Conservation (Chapter 5D.3)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$14,000	$14,000	$1,000	$1,000	$1,000	$1,000
Unit Cost ($/ac-ft)	$500	$500	$36	$36	$36	$36

* Unit costs for this plan element are rounded.

ND = Not Determined due to high variability in costs associated with manufacturing BMPs.

5B.9.7 Steam-Electric

No steam-electric demand exists or is currently projected for the county.

5B.9.8 Mining

Live Oak County mining users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Live Oak Mining and no changes in water supply are recommended.

5B.9.9 Irrigation

Live Oak County irrigation users receive groundwater supplies from the Gulf Coast Aquifer and surface water supplies in 2020. Shortages are projected for Live Oak County Irrigation throughout the planning period. The recommended water supply management plan is shown in Table 5B.9.10.

Table 5B.9.10.
Recommended Water Supply Plan for Live Oak County Irrigation

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(343)	(534)	(534)	(534)	(534)	(534)
Recommended Plan						
Irrigation Water Conservation	41	82	122	163	204	245
Gulf Coast Aquifer Supplies	534	534	534	534	534	534
Total New Supply	**575**	**616**	**656**	**697**	**738**	**779**
New Balance	**232**	**82**	**122**	**163**	**204**	**245**

Estimated costs of the recommended plan for Live Oak County Irrigation are shown in Table 5B.9.11.

Table 5B.9.11.
Recommended Water Supply Plan for Live Oak County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Irrigation Water Conservation (Chapter 5D.2)						
Annual Cost ($/yr)	$112,781	$225,562	$338,343	$451,124	$563,905	$676,687
Unit Cost ($/ac-ft)*	$2,768	$2,768	$2,768	$2,768	$2,768	$2,768
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$76,000	$76,000	$11,000	$11,000	$11,000	$11,000
Unit Cost ($/ac-ft)*	$142	$142	$21	$21	$21	$21

* Unit costs for this plan element are rounded.

5B.9.10 Livestock

The livestock demands in Live Oak County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.10 McMullen County Water Supply Plan

Table 5B.10.1 lists each water user group in McMullen County and their corresponding surplus or shortage in years 2040 and 2070. No water supply shortages are projected for McMullen County throughout the planning period.

Table 5B.10.1.
McMullen County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

1 From Tables 4A.18 and 4A.19, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.10.1 County-Other

The McMullen County-Other municipal users receive groundwater supplies from the Carrizo Aquifer. No shortages are projected for McMullen County-Other entities and no changes in water supply are recommended.

5B.10.2 Manufacturing

Manufacturing users in McMullen County obtain groundwater from the Gulf Coast Aquifer. No shortages are projected for McMullen County Manufacturing entities and no changes in water supply are recommended.

5B.10.3 Steam-Electric

No steam-electric demand exists or is projected for the county.

5B.10.4 Mining

Mining users in McMullen County obtain water from the Carrizo, Gulf Coast, Queen City, and Sparta aquifers. No shortages are projected for McMullen County Mining entities and no changes in water supply are recommended.

5B.10.5 Irrigation

No irrigation demand exists or is projected for the county.

5B.10.6 Livestock

The livestock water demands in McMullen County are met by groundwater from the Carrizo Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.11 Nueces County Water Supply Plan

Table 5B.11.1 lists each water user group in Nueces County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.11.1. Nueces County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2040 (ac-ft/yr)	Surplus/(Shortage)[1] 2070 (ac-ft/yr)	Comment
City of Aransas Pass	0	0	Supply equals demand
City of Bishop	0	0	Supply equals demand
City of Corpus Christi	0	0	Supply equals demand
Corpus Christi Naval Air	0	0	Supply equals demand
City of Driscoll	0	0	Supply equals demand
Nueces County WCID 3	(3,760)	(3,736)	Projected shortage – see plan below
Nueces County WCID 4	0	0	Supply equals demand
Nueces WSC	0	0	Supply equals demand
River Acres WSC	(270)	(293)	Projected shortage – see plan below
Violet WSC	0	0	Supply equals demand
County-Other	(1,430)	(1,364)	Projected shortage – see plan below
Manufacturing	(11,685)	(16,587)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	(836)	(1,127)	Projected shortage – see plan below
Irrigation	(51)	(51)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A.20 and 4A.21, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.11.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties, with the majority of demand lying in San Patricio County. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties, and no changes in water supply are recommended.

5B.11.2 City of Bishop

The City of Bishop has a contract with STWA to purchase treated surface water. Additionally, the City pumps groundwater from the Gulf Coast Aquifer. No shortages are projected for the City of Bishop; however, additional water conservation is a recommended water management strategy for the City (Table 5B.11.2).

Table 5B.11.2.
Recommended Water Supply Plan for the City of Bishop

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	43	26	23	22	22
New Balance	**0**	**43**	**26**	**23**	**22**	**22**

Estimated costs of the recommended plan for the City of Bishop are shown in Table 5B.11.3.

Table 5B.11.3.
Recommended Plan Costs by Decade for the City of Bishop

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$21,384	$13,015	$11,655	$11,069	$11,099
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.11.3 City of Corpus Christi

The City of Corpus Christi meets demands with its own water rights in the CCR/LCC System, through a contract with the Lavaca-Navidad River Authority (LNRA) that provides water from Lake Texana, and supplies associated with water rights in the Colorado River Basin delivered through the Mary Rhodes Pipeline- Phase II project. Although no shortages are projected for the City's own municipal needs, the City also provides surface water to SPMWD, STWA, various nearby cities, and manufacturing and steam-electric water user groups in Nueces and San Patricio Counties. Shortages are assigned to manufacturing water user groups in Nueces and San Patricio Counties. The recommended water supply management plan is shown in Table 5B.11.4. The total project yield for the Corpus Christi seawater desalination project is larger than shown in the table below. The Corpus Christi Inner Harbor seawater desalination project yield is 11,201 ac-ft/yr. Supplies were divided equally between the City of Corpus Christi and Nueces County-Manufacturing for the Corpus Christi seawater desalination project.

Table 5B.11.4.
Recommended Water Supply Plan for the City of Corpus Christi

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	5,028	10,439	10,550	10,648	10,779
Seawater Desalination	–	5,601	5,601	5,601	5,601	5,601
New Balance	**0**	**10,629**	**16,040**	**16,151**	**16,249**	**16,380**

Estimated costs of the recommended plan for the City of Corpus Christi are shown in Table 5B.11.5.

Table 5B.11.5.
Recommended Plan Costs by Decade for the City of Corpus Christi

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$2,529,087	$5,250,958	$5,306,806	$5,356,195	$5,421,820
Unit Cost ($/ac-ft)	–	$503	$503	$503	$503	$503
Seawater Desalination – Corpus Christi (Inner Harbor) 10 MGD* (Chapter 5D.10)						
Annual Cost ($/yr)	–	$18,021,000	$18,021,000	$9,514,000	$9,514,000	$9,514,000
Unit Cost ($/ac-ft)*	–	$3,218	$3,218	$1,731	$1,731	$1,731

* Note: Seawater Desalination costs do not include transmission pipelines for delivery to point of use.

5B.11.4 Corpus Christi Naval Air Station

The Corpus Christi Naval Air Station obtains treated surface water from the City of Corpus Christi. No shortages are projected for the air station; however, additional water conservation is a recommended water management strategy (Table 5B.11.6).

Table 5B.11.6.
Recommended Water Supply Plan for the Corpus Christi Naval Air Station

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	109	220	325	423	515
New Balance	**0**	**109**	**220**	**325**	**423**	**515**

Estimated costs of the recommended plan for the Corpus Christi Naval Air Station are shown in Table 5B.11.7.

Table 5B.11.7.
Recommended Plan Costs by Decade for the Corpus Christi Naval Air Station

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$54,653	$110,142	$162,696	$211,678	$257,327
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.11.5 City of Driscoll

The City of Driscoll purchases treated surface water from STWA, which originates from the CCR/LCC/Texana/MRP Phase II System. No shortages are projected for the City of Driscoll and no changes in water supply are recommended.

5B.11.6 Nueces County WCID 3

Nueces County WCID has a water right to divert supply from the Nueces River. Shortages are projected for Nueces County WCID 3 throughout the planning period. The total project yield for the local balancing storage are larger than shown in the table below. The local balancing storage yield is 4,058 ac-ft/yr. Supplies were divided between Nueces County WCID 3 and River Acres WSC, and assigned based on need.

The recommended water supply management plan is shown in Table 5B.11.8.

Table 5B.11.8. Recommended Water Supply Plan for Nueces County WCID 3

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(3,812)	(3,800)	(3,760)	(3,741)	(3,737)	(3,736)
Recommended Plan						
Municipal Water Conservation	0	328	638	936	1,219	1,477
Local Balancing Storage	3,824	3,800	3,788	3,780	3,771	3,765
Total New Supply	**3,824**	**4,128**	**4,426**	**4,716**	**4,990**	**5,242**
New Balance	**12**	**328**	**666**	**975**	**1,253**	**1,506**

Estimated costs of the recommended plan for Nueces County WCID 3 are shown in Table 5B.11.9.

Table 5B.11.9. Recommended Water Supply Plan for Nueces County WCID 3

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$163,195	$317,761	$466,100	$606,821	$735,390
Unit Cost ($/ac-ft)*	–	$498	$498	$498	$498	$498
Local Balancing Storage (Chapter 5D.6)						
Annual Cost ($/yr)	$1,546,374	$1,536,668	$638,490	$637,141	$635,792	$634,443
Unit Cost ($/ac-ft)	$426	$426	$98	$98	$98	$98

* Unit costs for this plan element are rounded.

5B.11.7 Nueces County WCID 4

Nueces County WCID 4 obtains treated surface water supply from the City of Corpus Christi. No shortages are projected for Nueces County WCID 4; however, additional water conservation is a recommended water management strategy for the WCID (Table 5B.11.10).

Table 5B.11.10.
Recommended Water Supply Plan for Nueces County WCID 4

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	233	473	706	929	1,134
New Balance	**0**	**233**	**473**	**706**	**929**	**1,134**

Estimated costs of the recommended plan for Nueces County WCID 4 are shown in Table 5B.11.11.

Table 5B.11.11.
Recommended Plan Costs by Decade for Nueces County WCID 4

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$116,713	$236,691	$353,151	$464,583	$566,878
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.11.8 Nueces WSC

Nueces WSC has a contract with the South Texas Water Authority (STWA) to purchase treated surface water from the CCR/LCC/Texana/MRP Phase II System. The Nueces WSC provides water supplies to a number of small rural entities in Nueces County as shown in Figure 3.3. No shortages are projected for Nueces WSC; however, additional water conservation is a recommended water management strategy for the WSC (Table 5B.11.12).

Table 5B.11.12.
Recommended Water Supply Plan for Nueces WSC

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	31	28	29	30	35
New Balance	**0**	**31**	**28**	**29**	**30**	**35**

Estimated costs of the recommended plan for Nueces WSC are shown in Table 5B.11.13.

Table 5B.11.13.
Recommended Plan Costs by Decade for Nueces WSC

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$15,439	$14,165	$14,355	$15,222	$17,749
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.11.9 River Acres WSC

River Acres WSC obtains its water from Nueces County WCID 3. Shortages are projected for River Acres WSC throughout the planning period. The recommended water supply management plan is shown in Table 5B.11.14. The local balancing storage would be owned and operated by Nueces County WCID 3. See discussion above in 5D.11.6.

Table 5B.11.14.
Recommended Water Supply Plan for River Acres WSC

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(234)	(258)	(270)	(278)	(287)	(293)
Recommended Plan						
Local Balancing Storage	234	258	270	278	287	293
Total New Supply	**234**	**258**	**270**	**278**	**287**	**293**
New Balance	**0**	**0**	**0**	**0**	**0**	**0**

Estimated costs of the recommended plan for River Acres WSC are shown in Table 5B.11.15.

Table 5B.11.15.
Recommended Plan Costs by Decade for River Acres WSC

Plan Element	2020	2030	2040	2050	2060	2070
Local Balancing Storage (Chapter 5D.6)						
Annual Cost ($/yr)	$94,626	$104,332	$45,510	$46,859	$48,208	$49,557
Unit Cost ($/ac-ft)*	$426	$426	$98	$98	$98	$98

* Unit costs for this plan element are rounded.

5B.11.10 Violet WSC

Violet WSC obtains treated surface water supply from the City of Corpus Christi. No shortages are projected for the WSC and no changes in water supply are recommended.

5B.11.11 County-Other

Nueces County-Other entities obtain surface water from various water providers, including STWA, and groundwater from the Gulf Coast Aquifer. Shortages are projected for Nueces County-Other entities throughout the planning period. The recommended water supply management plan is shown in Table 5B.11.16.

Table 5B.11.16. Recommended Water Supply Plan for Nueces County-Other

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(1,245)	(1,356)	(1,430)	(1,435)	(1,417)	(1,364)
Recommended Plan						
Gulf Coast Aquifer Supplies	1,435	1,435	1,435	1,435	1,435	1,435
New Balance	**190**	**79**	**5**	**0**	**18**	**71**

Estimated costs of the recommended plan for Nueces County-Other are shown in Table 5B.11.17.

Table 5B.11.17. Recommended Plan Costs by Decade for Nueces County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$462,000	$462,000	$144,000	$144,000	$144,000	$144,000
Unit Cost ($/ac-ft)*	$322	$322	$100	$100	$100	$100

* Unit costs for this plan element are rounded.

5B.11.12 Manufacturing

The City of Corpus Christi provides treated and raw surface water for manufacturing in Nueces County from the CCR/LCC/Texana/MRP Phase II System. Additional manufacturing supplies are from the Gulf Coast Aquifer and reuse supplies. The City also provides surface water for manufacturing in San Patricio County. A shortage in manufacturing supply occurs beginning in 2030. The recommended water supply plan for Nueces County Manufacturing is shown below (Table 5B.11.18). The recommended strategies Seawater Desalination- Corpus Christi (Inner Harbor) and Evangeline/Laguna LP Groundwater Desalination project shown would likely be jointly developed by the City of Corpus Christi and the SPMWD. Note: The total project yield for O.N. Stevens WTP improvement, Evangeline/Laguna LP Groundwater Desalination project, and PCCA Harbor Island seawater desalination project is larger than shown in the table below. The Corpus Christi Inner Harbor seawater desalination project yield is 11,201 ac-ft/yr, the Port Harbor Island seawater desalination project yield is 56,044 ac-ft/yr, and the O.N. Stevens WTP Improvement project yield is 32,030 ac-ft/yr. Supplies were divided equally between Nueces County-Manufacturing and the City of Corpus Christi for the Corpus Christi Inner Harbor seawater desalination project, and between Nueces County-Manufacturing and San Patricio County-Manufacturing for the O.N. Stevens WTP Improvement, Evangeline/Laguna LP Groundwater Desalination Project, and PCCA Harbor Island desalination project. The manufacturing water conservation yield for Nueces County is 1,135 ac-ft/yr in 2020 and increases to 7,554 ac-ft/yr by 2070.

Table 5B.11.18. Recommended Water Supply Plan for Nueces County Manufacturing

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	(9,084)	(11,685)	(13,339)	(15,228)	(16,587)
Recommended Plan						
Manufacturing Water Conservation	1,135	2,518	3,777	5,036	6,295	7,554
O.N. Stevens WTP Improvements	16,015	16,015	16,015	16,015	16,015	16,015
Aquifer Storage and Recovery	–	14,573	14,573	14,573	14,573	14,573
Evangeline/Laguna LP Groundwater Desalination*	–	9,949	9,949	11,394	11,394	11,394
Seawater Desalination – Corpus Christi (Inner Harbor)	–	5,601	5,601	5,601	5,601	5,601
Seawater Desalination – Port Harbor Island	–	28,022	28,022	28,022	28,022	28,022
Total New Supply	**17,150**	**76,678**	**77,937**	**80,641**	**81,900**	**83,159**
New Balance (Treated)	**17,150**	**67,594**	**66,252**	**67,302**	**66,672**	**66,572**

*Supply increases at 2050 due to yield changes in response to MAG availability.

Estimated costs of the recommended plan for Nueces County Manufacturing are shown in Table 5B.11.19.

Table 5B.11.19.
Recommended Plan Costs by Decade for Nueces County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Manufacturing Water Conservation (Chapter 5D.3)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
O.N. Stevens WTP Improvements (Chapter 5D.11)						
Annual Cost ($/yr)	$3,133,000	$3,133,000	$733,500	$733,500	$733,500	$733,500
Unit Cost ($/ac-ft)*	$565	$565	$415	$415	$415	$415
Aquifer Storage and Recovery (Chapter 5D.7)						
Annual Cost ($/yr)	–	$8,836,000	$8,836,000	$2,489,000	$2,489,000	$2,489,000
Unit Cost ($/ac-ft)	–	$606	$606	$171	$171	$171
Evangeline/Laguna LP Groundwater Desalination (Chapter 5D.9)						
Annual Cost ($/yr)	–	$17,579,500	$17,579,500	$12,037,000	$12,037,000	$12,037,000
Unit Cost ($/ac-ft)	–	$1,767	$1,767	$1,150	$1,150	$1,150
Seawater Desalination – Corpus Christi (Inner Harbor) 10 MGD (Chapter 5D.10)**						
Annual Cost ($/yr)	–	$18,021,000	$18,021,000	$9,514,000	$9,514,000	$9,514,000
Unit Cost ($/ac-ft)	–	$3,218	$3,218	$1,731	$1,731	$1,731
Seawater Desalination – PCCA Harbor Island 50 MGD* (Chapter 5D.10)**						
Annual Cost ($/yr)	–	$65,083,500	$65,083,500	$36,840,500	$36,840,500	$36,840,500
Unit Cost ($/ac-ft)	–	$2,323	$2,323	$1,315	$1,315	$1,315

* Unit cost for Regional WTP upgrades includes treatment of $369 per ac-ft.
** Note: Seawater Desalination costs do not include transmission pipelines for delivery to point of use.
***Note: Seawater Desalination costs estimate 2 mile line for delivery to point of use.
ND = Not Determined due to high variability in costs associated with manufacturing BMPs.

5B.11.13 Steam-Electric

The steam-electric users in Nueces County are provided water by City of Corpus Christi. No shortages are projected for steam-electric users and no changes in water supply are recommended.

5B.11.14 Mining

Nueces County Mining users obtain water supplies from the Gulf Coast Aquifer. Shortages are projected for mining users throughout the planning period. The recommended water supply management plan is shown in Table 5B.11.20.

Table 5B.11.20.
Recommended Water Supply Plan for Nueces County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(629)	(749)	(836)	(905)	(1,006)	(1,127)
Recommended Plan						
Mining Water Conservation	1	2	3	4	6	8
Gulf Coast Aquifer Supplies	1,127	1,127	1,127	1,127	1,127	1,127
Total New Supply	**1,128**	**1,129**	**1,130**	**1,131**	**1,133**	**1,135**
New Balance	**499**	**380**	**294**	**226**	**127**	**8**

Estimated costs of the recommended plan for Nueces County Mining are shown in Table 5B.11.21.

Table 5B.11.21.
Recommended Water Supply Plan for Nueces County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$178,000	$178,000	$23,000	$23,000	$23,000	$23,000
Unit Cost ($/ac-ft)	$158	$158	$20	$20	$20	$20

ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.11.15 Irrigation

Irrigation users in Nueces County obtain water supplies from the Gulf Coast Aquifer. Shortages are projected for irrigation users throughout the planning period. The recommended water supply management plan is shown in Table 5B.11.22.

Table 5B.11.22.
Recommended Water Supply Plan for Nueces County Irrigation

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(51)	(51)	(51)	(51)	(51)	(51)
Recommended Plan						
Irrigation Water Conservation	1	3	4	5	6	8
Gulf Coast Aquifer Supplies	51	51	51	51	51	51
Total New Supply	**52**	**54**	**55**	**56**	**57**	**59**
New Balance	**1**	**3**	**4**	**5**	**6**	**8**

Estimated costs of the recommended plan for Nueces County Irrigation are shown in Table 5B.11.23.

Table 5B.11.23.
Recommended Plan Costs by Decade for Nueces County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Irrigation Water Conservation (Chapter 5D.2)						
Annual Cost ($/yr)	$2,533	$5,065	$7,598	$10,130	$12,663	$15,196
Unit Cost ($/ac-ft)*	$1,986	$1,986	$1,986	$1,986	$1,986	$1,986
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$24,000	$24,000	$2,000	$2,000	$2,000	$2,000
Unit Cost ($/ac-ft)*	$471	$471	$39	$39	$39	$39

* Unit costs for this plan element are rounded.

5B.11.16 Livestock

The livestock demands in Nueces County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.12 San Patricio County Water Supply Plan

Table 5B.12.1 lists each water user group in San Patricio County and their corresponding surplus or shortage in years 2040 and 2070. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.12.1.
San Patricio County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Aransas Pass	0	0	Supply equals demand
City of Gregory	0	0	Supply equals demand
City of Ingleside	0	0	Supply equals demand
City of Mathis	0	0	Supply equals demand
City of Odem	0	0	Supply equals demand
City of Portland	0	0	Supply equals demand
Rincon WSC	0	0	Supply equals demand
City of Sinton	0	0	Supply equals demand
City of Taft	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	(9,533)	(17,563)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	(305)	(398)	Projected shortage – see plan below
Irrigation	(204)	(204)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A.22 and 4A.23, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.12.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties, with the majority of demand lying in San Patricio County. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties, and no changes in water supply are recommended.

5B.12.2 City of Gregory

The City of Gregory has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Gregory; however, additional water conservation is a recommended water management strategy for the City (Table 5B.12.2).

Table 5B.12.2.
Recommended Water Supply Plan for the City of Gregory

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	11	6	6	4	4
New Balance	**0**	**11**	**6**	**6**	**4**	**4**

Estimated costs of the recommended plan for the City of Gregory are shown in Table 5B.12.3.

Table 5B.12.3.
Recommended Plan Costs by Decade for the City of Gregory

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$5,535	$3,144	$2,851	$2,156	$2,166
Unit Cost ($/ac-ft)*	–	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.12.3 City of Ingleside

The City of Ingleside has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Ingleside and no changes in water supply are recommended.

5B.12.4 City of Mathis

The City of Mathis has a contract with the City of Corpus Christi to purchase raw water from the CCR/LCC/Texana/MRP Phase II System. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Mathis and no changes in water supply are recommended.

5B.12.5 City of Odem

The City of Odem has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Odem and no changes in water supply are recommended.

5B.12.6 City of Portland

The City of Portland has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Portland and no changes in water supply are recommended.

5B.12.7 Rincon WSC

Rincon WSC has a contract with the SPMWD to purchase treated water. The contract allows the WSC to purchase only the water that it needs. No shortages are projected for Rincon WSC and no changes in water supply are recommended.

5B.12.8 City of Sinton

The City of Sinton meets its demands with groundwater pumped from the Gulf Coast Aquifer. No shortages are projected for the City of Sinton; however, additional water conservation is a recommended water management strategy for the City (Table 5B.12.4).

Table 5B.12.4.
Recommended Water Supply Plan for the City of Sinton

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	106	211	319	427	430
New Balance	**0**	**106**	**211**	**319**	**427**	**430**

Estimated costs of the recommended plan for the City of Sinton are shown in Table 5B.12.5.

Table 5B.12.5.
Recommended Plan Costs by Decade for the City of Sinton

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	–	$53,019	$105,683	$159,676	$213,516	$214,823
Unit Cost ($/ac-ft)	–	$500	$500	$500	$500	$500

5B.12.9 City of Taft

The City of Taft has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Taft and no changes in water supply are recommended.

5B.12.10 County-Other

County-Other demands are met with surface water from the CCR/LCC/Texana/MRP Phase II System provided by the SPMWD and groundwater from the Gulf Coast Aquifer. No shortages are projected for County-Other entities and no changes in water supply are recommended.

5B.12.11 Manufacturing

The City of Corpus Christi provides the surface water for manufacturing in San Patricio County through the SPMWD from the CCR/LCC/Texana/MRP Phase II System. A small amount of manufacturing supplies are from the Gulf Coast Aquifer and reuse supplies. The City also provides surface water for manufacturing in Nueces County. A shortage in manufacturing supply occurs beginning in 2030. The recommended water supply plan for San Patricio County Manufacturing is shown below (Table 5B.12.6). The recommended Seawater Desalination-Corpus Christi (La Quinta) project shown would likely be jointly developed by the City of Corpus Christi and the SPMWD. Note: The total project yield for O.N. Stevens WTP improvement, Evangeline/Laguna LP Groundwater Desalination project, and PCCA Harbor Island seawater desalination project is larger than shown in the table below. Supplies were divided equally between Nueces County-Manufacturing and San Patricio County-Manufacturing for the O.N. Stevens WTP Improvement, Evangeline/Laguna LP Groundwater Desalination, and PCCA Harbor Island desalination projects. The manufacturing water conservation yield for San Patricio Counties is 971 ac-ft/yr in 2020 and increases to 6,483 ac-ft/yr by 2070.

Table 5B.12.6.
Recommended Water Supply Plan for San Patricio County Manufacturing

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	190	(7,059)	(9,533)	(12,111)	(14,705)	(17,563)
Recommended Plan						
Manufacturing Water Conservation	971	2,161	3,242	4,322	5,403	6,483
O.N. Stevens WTP Improvements	16,015	16,015	16,015	16,015	16,015	16,015
Regional Industrial Wastewater Reuse Plan (SPMWD)	–	5,010	5,010	5,010	5,010	5,010
Evangeline/Laguna LP Groundwater Desalination*	–	9,949	9,949	11,394	11,394	11,394
Seawater Desalination – Corpus Christi (La Quinta)	–	22,402	22,402	22,402	22,402	22,402
Seawater Desalination – Ingleside-Poseidon	–	56,044	56,044	56,044	56,044	56,044
Seawater Desalination – Port La Quinta	–	33,604	33,604	33,604	33,604	33,604
Seawater Desalination – Port Harbor Island	–	28,022	28,022	28,022	28,022	28,022
Total New Supply	**16,986**	**173,207**	**174,288**	**176,813**	**177,894**	**178,974**
New Balance (Treated)	**17,176**	**150,133**	**148,740**	**148,687**	**147,174**	**145,396**

*Supply increases at 2050 due to yield changes in response to MAG availability.

Estimated costs of the recommended plan for San Patricio County Manufacturing are shown in Table 5B.12.7.

Table 5B.12.7.
Recommended Plan Costs by Decade for San Patricio County Manufacturing

Plan Element	2020	2030	2040	2050	2060	2070
Manufacturing Water Conservation (Chapter 5D.3)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
O.N. Stevens WTP Improvements (Chapter 5D.11)						
Annual Cost ($/yr)	$3,133,000	$3,133,000	$733,500	$733,500	$733,500	$733,500
Unit Cost ($/ac-ft)*	$565	$565	$415	$415	$415	$415
Regional Industrial Wastewater Reuse Plan (SPMWD) 4.47 MGD (Chapter 5D.5)						
Annual Cost ($/yr)	–	$8,475,000	$8,475,000	$348,000	$348,000	$348,000
Unit Cost ($/ac-ft)	–	$1,692	$1,692	$69	$69	$69
Evangeline/Laguna LP Groundwater Desalination (Chapter 5D.9)						
Annual Cost ($/yr)	–	$17,579,500	$17,579,500	$12,037,000	$12,037,000	$12,037,000
Unit Cost ($/ac-ft)	–	$1,767	$1,767	$1,150	$1,150	$1,150
Seawater Desalination – Corpus Christi (La Quinta) 20 MGD (Chapter 5D.10)						
Annual Cost ($/yr)	–	$62,720,000	$62,720,000	$33,142,000	$33,142,000	$33,142,000
Unit Cost ($/ac-ft)	–	$2,800	$2,800	$1,479	$1,479	$1,479
Seawater Desalination – Ingleside-Poseidon 50 MGD (Chapter 5D.10)						
Annual Cost ($/yr)	–	$123,638,000	$123,638,000	$72,627,000	$72,627,000	$72,627,000
Unit Cost ($/ac-ft)	–	$2,206	$2,206	$1,296	$1,296	$1,296
Seawater Desalination – Port La Quinta 30 MGD (Chapter 5D.10)						
Annual Cost ($/yr)	–	$77,991,000	$77,991,000	$45,784,000	$45,784,000	$45,784,000
Unit Cost ($/ac-ft)	–	$2,321	$2,321	$1,362	$1,362	$1,362
Seawater Desalination – Port Harbor Island 50 MGD (Chapter 5D.10)						
Annual Cost ($/yr)	–	$65,083,500	$65,083,500	$36,840,500	$36,840,500	$36,840,500
Unit Cost ($/ac-ft)	–	$2,323	$2,323	$1,315	$1,315	$1,315

* Unit cost for Regional WTP upgrades includes treatment of $369 per ac-ft.

***Note: Seawater Desalination costs estimate 2 mile line for delivery to point of use.

ND = Not Determined due to high variability in costs associated with manufacturing BMPs.

5B.12.12 Steam-Electric

Steam-electric demands in San Patricio County are met by water from the SPMWD. No shortages are projected for steam-electric users and no changes in water supply are recommended.

5B.12.13 Mining

Mining users in San Patricio County obtain water supply from the Gulf Coast Aquifer. Shortages are projected for mining throughout the planning period. The recommended water supply management plan is shown in Table 5B.12.8.

Table 5B.12.8.
Recommended Water Supply Plan for San Patricio County Mining

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(237)	(286)	(305)	(325)	(357)	(398)
Recommended Plan						
Mining Water Conservation	7	17	26	36	49	63
Gulf Coast Aquifer Supplies	398	398	398	398	398	398
Total New Supply	**405**	**415**	**424**	**434**	**447**	**461**
New Balance	**168**	**129**	**119**	**109**	**90**	**63**

Estimated costs of the recommended plan for San Patricio County Mining are shown in Table 5B.12.9.

Table 5B.12.9.
Recommended Plan Costs by Decade for San Patricio County Mining

Plan Element	2020	2030	2040	2050	2060	2070
Mining Water Conservation (Chapter 5D.4)						
Annual Cost ($/yr)	ND	ND	ND	ND	ND	ND
Unit Cost ($/ac-ft)	ND	ND	ND	ND	ND	ND
Drill New Well (Chapter 5D.8.1)						
Annual Cost ($/yr)	$91,000	$91,000	$11,000	$11,000	$11,000	$11,000
Unit Cost ($/ac-ft)	$229	$229	$28	$28	$28	$28

ND = Not Determined due to high variability in costs associated with mining BMPs.

5B.12.14 Irrigation

Irrigation users in San Patricio County obtain water from the Gulf Coast Aquifer. Shortages are projected for irrigation users throughout the planning period. The recommended water supply management plan for irrigation entities is shown in Table 5B.12.10.

Table 5B.12.10.
Recommended Water Supply Plan for San Patricio County Irrigation

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	(204)	(204)	(204)	(204)	(204)	(204)
Recommended Plan						
Irrigation Water Conservation	366	732	1,098	1,465	1,831	2,197
Gulf Coast Aquifer Supplies	204	204	204	204	204	204
Total New Supply	**570**	**936**	**1,302**	**1,669**	**2,035**	**2,401**
New Balance	**366**	**732**	**1,098**	**1,465**	**1,831**	**2,197**

Estimated costs of the recommended plan for San Patricio County Irrigation are shown in Table 5B.12.11.

Table 5B.12.11.
Recommended Plan Costs by Decade for San Patricio County Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
Irrigation Water Conservation (Chapter 5D.2)						
Annual Cost ($/yr)	$1,304,876	$2,609,753	$3,914,629	$5,219,506	$6,524,382	$7,829,259
Unit Cost ($/ac-ft)*	$3,564	$3,564	$3,564	$3,564	$3,564	$3,564
Drill New Well(s) (Chapter 5D.9)						
Annual Cost ($/yr)	$33,000	$33,000	$3,000	$3,000	$3,000	$3,000
Unit Cost ($/ac-ft)	$162	$162	$15	$15	$15	$15

* Unit costs for this plan element are rounded.

5B.12.15 Livestock

The livestock water demands in San Patricio County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5B.13 Wholesale Water Provider Water Supply Plans

Table 5B.13.1 lists each Wholesale Water Provider and their corresponding surplus or shortage in years 2040 and 2070. For each Wholesale Water Provider with a projected shortage, a water supply plan has been developed.

Table 5B.13.1.
Wholesale Water Provider Surplus/(Shortage)

Wholesale Water Provider	Surplus/(Shortage)[1]		Comment
	2040 (ac-ft/yr)	2070 (ac-ft/yr)	
City of Corpus Christi[2]	(21,218)	(34,150)	Projected shortage – see plan below
San Patricio MWD	(9,533)	(17,563)	Projected shortage – see plan below
South Texas Water Authority	0	0	Supply equals demand
Nueces County WCID 3	(4,030)	(4,029)	Projected shortage – see plan below

1 Surplus/(Shortage) for each Wholesale Water Provider calculated by taking total surface water availability (constrained by water treatment plant capacity) less municipal retail and wholesale demands, steam-electric demands, manufacturing demands, and/or mining demands (Table 4A.24).

2 The City of Corpus Christi provides water supplies to SPMWD to meet San Patricio County-Manufacturing demands. The total shortages shown for the City of Corpus Christi include both the needs of Nueces County- Manufacturing and those required by SPMWD to meet San Patricio County-Manufacturing demands (i.e. San Patricio MWD shortage).

5B.13.1 City of Corpus Christi

As the primary provider of surface water to the Coastal Bend Region, the City of Corpus Christi is the major Wholesale Water Provider in the region. Corpus Christi has 167,000 ac-ft in available safe yield supply in 2070 through its own water right in the CCR/LCC/Texana/MRP Phase II System. This includes contracted supplies with LNRA from Lake Texana, after exercising LNRA's call-back provision for Jackson County users in addition to up to 35,000 ac-ft/yr from the Garwood water rights located on the Colorado River.

The City provides treated and raw water from the CCR/LCC/Texana/MRP Phase II System to the water user groups and other entities shown in Table 5B.13.2.

Table 5B.13.2.
Purchasers of Water from the City of Corpus Christi

Water User Group / Entity	County
San Patricio MWD	San Patricio
South Texas Water Authority	Kleberg, Nueces
City of Alice	Jim Wells
City of Beeville	Bee
Corpus Christi Naval Air Station	Nueces
City of Mathis	San Patricio
City of Three Rivers	Live Oak
Nueces County WCID 4 (Port Aransas)	Nueces

Violet WSC	Nueces
Steam-Electric	Nueces
Manufacturing	Nueces

The shortage listed in Table 5B.13.1 reflects the entire City's demands — both municipal retail and wholesale, as well as steam-electric and manufacturing demands, taking water treatment plant constraints into consideration. The shortage begins in 2030 and is due to large manufacturing demands in Nueces and San Patricio Counties. For a list of the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in Nueces County in Chapter 5B.11.12.

5B.13.2 San Patricio Municipal Water District

The San Patricio Municipal Water District (SPMWD) is the second largest Wholesale Water Provider in the region. SPMWD has a contract with the City of Corpus Christi to purchase water from the CCR/LCC/Texana/MRP Phase II System. SPMWD treats this water and provides it to the water user groups and other entities shown in Table 5B.13.3.

Table 5B.13.3.
Purchasers of Water from San Patricio MWD

Water User Group / Entity	County
City of Aransas Pass	Aransas, Nueces, San Patricio
City of Gregory	San Patricio
City of Ingleside	San Patricio
City of Odem	San Patricio
City of Portland	San Patricio
City of Rockport	Aransas
City of Taft	San Patricio
Rincon WSC	San Patricio
Nueces WCID 4 (Port Aransas)	Nueces
County-Other	Aransas, San Patricio
Steam- Electric	San Patricio
Manufacturing	San Patricio

The shortage listed in Table 5B.13.1 reflects all of SPMWD's demands — both municipal retail and wholesale, as well as manufacturing demands. The shortage also takes into account water availability constraints in the CCR/LCC/Texana/MRP Phase II. SPMWD has adequate contracts in place with the City of Corpus Christi to meet demands through 2070. The shortage begins in 2030 is due to large manufacturing demands in San Patricio County. For the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in San Patricio County in Chapter 5B.12.11.

5B.13.3 South Texas Water Authority

The South Texas Water Authority (STWA) is the third largest Wholesale Water Provider in the region. STWA has a contract with the City of Corpus Christi to purchase treated water from the CCR/LCC/Texana/MRP Phase II System. STWA provides this water to the water user groups and other entities shown in Table 5B.13.4.

Table 5B.13.4.
Purchasers of Water from South Texas Water Authority

Water User Group / Entity	County
City of Bishop	Nueces
City of Driscoll	Nueces
Nueces County-Other[1]	Nueces
Nueces WSC	Nueces
City of Kingsville	Kleberg
Ricardo WSC	Kleberg

[1] Includes City of Agua Dulce and Nueces County WCID #5.

There are no shortages listed in Table 5B.13.1 for South Texas Water Authority.

5B.13.4 Nueces County WCID 3

The Nueces County WCID 3 is the smallest Wholesale Water Provider in the region. Nueces County WCID 3 receives a firm yield of 324 ac-ft/yr from its Nueces Basin run-of-river rights. Nueces County WCID 3 provides this water to the water user groups and other entities shown in Table 5B.13.5.

Table 5B.13.5.
Purchasers of Water from Nueces County WCID 3

Water User Group / Entity	County
City of Robstown	Nueces
River Acres WSC	Nueces

Nueces County WCID 3 is projected to have a water shortage throughout the planning period. The plan for Nueces County WCID 3 is shown in Chapters 5B.11.6 and 5B.11.9.

5B.14 Summary of Recommended Water Management Strategies by Water User Group

A summary of recommended water management strategies for all water user groups is shown in Table 5B.14.1.

Table 5B.14.1.
Summary of Recommended Water Management Strategies in the Coastal Bend Region

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.1	**Municipal Water Conservation**	***Variable, Regional Cost up to $94,234,000***	***$498 - $503***	***$498 - $503***	***0***	***7,341***	***14,689***	***16,399***	***17,707***	***18,793***
	Rockport	$1,751,000	$498	$498	0	270	353	327	321	321
	Beeville	$3,991,000	$498	$498	0	254	502	757	806	806
	El Oso WSC	$111,000	$500	$500	0	7	14	22	19	19
	TDCJ Chase Field	$1,947,000	$500	$500	0	85	167	247	322	391
	Falfurrias	$3,423,000	$500	$500	0	132	266	406	546	688
	Freer WCID	$1,070,000	$500	$500	0	54	110	170	211	215
	San Diego MUD 1	$435,000	$500	$500	0	55	88	83	84	87
	Alice	$4,862,000	$498	$498	0	345	725	899	938	981
	Orange Grove	$1,153,000	$500	$500	0	40	83	131	181	232
	Premont	$1,504,000	$500	$500	0	58	120	194	268	302
	San Diego MUD 1	$103,000	$500	$500	0	13	21	19	19	20
	County-Other, Kenedy	$503,000	$500	$500	0	23	45	65	84	101
	County-Other, Kleberg	$51,000	$500	$500	0	10	6	6	6	6
	Naval Air Station Kingsville	$716,000	$500	$500	0	26	54	84	114	144
	El Oso WSC	$186,000	$500	$500	0	13	25	37	30	30
	George West	$207,000	$500	$500	0	30	42	39	38	38
	Three Rivers	$183,000	$500	$500	0	37	24	18	17	17
	Bishop	$213,000	$500	$500	0	43	26	23	22	22
	Corpus Christi	$53,940,000	$503	$503	0	5,028	10,439	10,550	10,648	10,779
	Corpus Christi Naval Air Station	$2,560,000	$500	$500	0	109	220	325	423	515
	Nueces County WCID 3	$7,316,000	$498	$498	0	328	638	936	1,219	1,477
	Nueces County WCID 4	$5,640,000	$500	$500	0	233	473	706	929	1,134
	Nueces WSC	$177,000	$500	$500	0	31	28	29	30	35
	Gregory	$55,000	$500	$500	0	11	6	6	4	4
	Sinton	$2,137,000	$500	$500	0	106	211	319	427	430

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.2	**Irrigation Water Conservation**	***Variable, Regional Cost up to $12,111,317***	***$1,911 - $4,822***	***$1,911 - $4,822***	***561***	***1,122***	***1,683***	***2,244***	***2,806***	***3,367***
	Bee County	$3,041,704	$4,822	$4,822	105	210	315	421	526	631
	Jim Wells County	$548,471	$1,911	$1,911	48	96	143	191	239	287
	Live Oak County	$676,687	$2,768	$2,768	41	82	122	163	204	245
	Nueces County	$15,196	$1,986	$1,986	1	3	4	5	6	8
	San Patricio County	$7,829,259	$3,564	$3,564	366	732	1,098	1,465	1,831	2,197
5D.3	**Manufacturing Water Conservation**				***2,210***	***4,912***	***7,367***	***9,823***	***12,279***	***14,735***
	Jim Wells County	N/A	N/A	N/A	2	5	7	10	12	14
	Kleberg County	N/A	N/A	N/A	45	103	154	206	257	308
	Live Oak County	N/A	N/A	N/A	57	125	187	249	312	374
	Nueces County	N/A	N/A	N/A	1,135	2,518	3,777	5,036	6,295	7,554
	San Patricio County	N/A	N/A	N/A	971	2,161	3,242	4,322	5,403	6,483
5D.4	**Mining Water Conservation**				***76***	***157***	***221***	***273***	***323***	***374***
	Bee County	N/A	N/A	N/A	10	20	28	33	37	42
	Brooks County	N/A	N/A	N/A	9	18	26	32	39	45
	Duval County	N/A	N/A	N/A	35	72	101	124	146	166
	Jim Wells County	N/A	N/A	N/A	2	4	4	4	3	3
	Kenedy County	N/A	N/A	N/A	3	6	7	7	5	4
	Kleberg County	N/A	N/A	N/A	9	18	26	32	39	45
	Nueces County	N/A	N/A	N/A	1	2	3	4	6	8
	San Patricio County	N/A	N/A	N/A	7	17	26	36	49	63
5D.5	**Reuse**									
	Regional Industrial Wastewater Reuse Plan (4.47 MGD)	$115,502,000	$1,692	$1,692	0	5,010	5,010	5,010	5,010	5,010
	City of Alice- Non-potable Reuse	$10,222,000	$1,449	$648	0	897	897	897	897	897
5D.6	**Local Balancing Storage Reservoir**	**$21,575,000**	**$426**	**$98**	**4,058**	**4,058**	**4,058**	**4,058**	**4,058**	**4,058**
5D.7	**City of Corpus Christi Aquifer Storage and Recovery**									
	Phase I (13 MGD)	$68,632,000 to $90,199,000	$479 to $606	$148 to $171	0	14,573	14,573	14,573	14,573	14,573

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.8	**Gulf Coast Aquifer Supplies**									
	Bee County-Other (Municipal)	$4,943,000	$328	$121	1,682	1,682	1,682	1,682	1,682	1,682
	El Oso WSC	$424,000	$553	$234	94	94	94	94	94	94
	Bee County- Irrigation	$1,166,000	$276	$43	352	352	352	352	352	352
	Bee County- Mining	$622,000	$259	$36	197	197	197	197	197	197
	TDCJ Chase Field	$703,000	$404	$168	208	208	208	208	208	208
	Brooks County-Other (Municipal)	$1,207,000	$430	$155	309	309	309	309	309	309
	Brooks County- Mining	$615,000	$291	$55	182	182	182	182	182	182
	Duval County-Other (Municipal)	$2,109,000	$442	$155	516	516	516	516	516	516
	Duval County- Mining	$3,228,000	$357	$61	768	768	768	768	768	768
	Duval County- San Diego MUD 1	$1,856,000	$453	$139	417	417	417	417	417	417
	Jim Wells County-Other (Municipal)	$10,704,000	$392	$108	2,650	2,650	2,650	2,650	2,650	2,650
	Jim Wells County- Irrigation	$753,000	$183	$24	333	333	333	333	333	333
	Jim Wells County- Manufacturing	$129,000	$688	$125	16	16	16	16	16	16
	Jim Wells County- Mining	$202,000	$309	$55	55	55	55	55	55	55
	Kenedy County- Mining	$469,000	$587	$63	63	63	63	63	63	63
	Kleberg County- Manufacturing	$852,000	$275	$32	247	247	247	247	247	247
	Kleberg County- Mining	$638,000	$359	$42	142	142	142	142	142	142
	Live Oak County- Irrigation	$917,000	$142	$21	534	534	534	534	534	534
	Live Oak County- Manufacturing	$188,000	$500	$36	28	28	28	28	28	28
	Nueces County- Other (Municipal)	$4,514,000	$322	$100	1,435	1,435	1,435	1,435	1,435	1,435
	Nueces County- Irrigation	$319,000	$471	$39	51	51	51	51	51	51
	Nueces County-Mining	$2,200,000	$158	$20	1,127	1,127	1,127	1,127	1,127	1,127
	San Patricio County- Irrigation	$420,000	$162	$15	204	204	204	204	204	204
	San Patricio County- Mining	$1,141,000	$229	$28	398	398	398	398	398	398

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost ($/ac-ft/yr)	Last Decade Estimated Unit Cost ($/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
5D.9	**Groundwater Desalination**									
	City of Alice- Brackish Groundwater Desalination	$23,983,000	$1,170	$668	0	3,360	3,360	3,360	3,360	3,360
	Evangeline/Laguna Groundwater Project (Treated)									
	Delivery Option 3- MAG constrained	$157,550,000	$1,767	$1,150	0	19,898	19,898	22,788	22,788	22,788
5D.10	**Seawater Desalination**									
	City of Corpus Christi- Inner Harbor (10 MGD)	$236,693,000	$3,218	$1,731	0	11,201	11,201	11,201	11,201	11,201
	City of Corpus Christi- La Quinta (20 MGD)	$420,372,000	$2,800	$1,479	0	22,402	22,402	22,402	22,402	22,402
	Poseidon Regional Seawater Desalination Project at Ingleside (50 MGD)	$724,984,000	$2,206	$1,296	0	56,044	56,044	56,044	56,044	56,044
	Port of Corpus Christi Authority- Harbor Island (50 MGD)	$802,807,000	$2,323	$1,315	0	56,044	56,044	56,044	56,044	56,044
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	$457,732,000	$2,321	$1,362	0	33,604	33,604	33,604	33,604	33,604
5D.11	**Regional Water Treatment Plant Facility Expansions- ON Stevens WTP**	**$68,212,000**	**$565**	**$415**	**32,030**	**32,030**	**32,030**	**32,030**	**32,030**	**32,030**

5C.1 Conservation Recommendations

Regional water planning guidelines require each region to consider water conservation to meet projected shortages, although funding to implement such water conservation programs is limited. Conservation is shown as a recommended strategy for all water user groups with needs identified for the planning period. The CBRWPG adopted the following conservation recommendations for the 2021 Plan.

- Municipal WUGs with per capita rates exceeding 140 gallons per person per day (gpcd) were recommended to reduce per capita consumption by 1% annually through 2070 until a 140 gpcd rate is attained. This recommendation applies to all municipal WUGs with and without projected water supply needs (or shortage).
- Irrigation, manufacturing, and mining water user groups with identified needs were recommended to reduce water use by 15% by 2070.
- Manufacturing WUGs report the largest identified needs in the region by category. Manufacturers were recommended to continue to pursue best management practices to reduce water consumption. Industries in the Coastal Bend Region have a good history of implementing water conservation practices, and report some of the lowest water use in the state per barrel of crude produced. The City of Corpus Christi directly, and indirectly through SPMWD, provides the majority of water for manufacturing water user groups with identified needs during the projection period.
- Conservation recommendations were not made for livestock water user groups.

A summary was prepared of common municipal water conservation best management practices appropriate for the region (Table 5C.1.1) and recommended 5- and 10-year water conservation targets (Table 5C.1.2). TWDB-provided information on implemented municipal water conservation programs in Region N based on progress reports voluntarily provided by water user groups is presented in Table 5C.1.3 through Table 5C.1.6. The CBRWPG recommends that water user groups in the region review the list and look to identify water user groups at a relevant size with similar water supply type and consider voluntary implementation of those best management practices, if applicable.

Based on the results from a survey conducted by the CBRWPG, water conservation grants or low-interest loans to implement the following BMPs in the Coastal Bend Region would be most beneficial in promoting efficient water use: 1) water conservation pricing; 2) prohibition on wasting water; 3) school education; 4) landscape irrigation conservation; 5) metering connections and retrofits; 6) plumbing retrofits and replacements; and 7) other BMPs identified by water user groups.

A Region N-specific model water conservation plan for municipal water users is included in Appendix D. These model plans include a list of best management practices in the region, to supplement TCEQ model water conservation plans found on TCEQ's website: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html

Table 5C.1.1.
Summary of Water Conservation BMPs in the Coastal Bend Region

Wholesale Water Provider	WCP Available	Date	Best Management Practices: Reduce Water Losses/ Unaccounted for Water/Leak Detection	Water Conservation Pricing/Seasonal or Inverted Block Rates	Reuse	Improve Meter Accuracy	Toilet Replacement/ Retrofit Programs	Public/School Education	Landscape Conservation/ Xeriscape	Others
City of Corpus Christi[1]	Y	2019	√	√	√	√		√	√	√
San Patricio Municipal Water District[1]	Y	2019	√	√	√	√		√	√	√
South Texas Water Authority[1]	Y	2018	√	√		√		√		
Nueces County WCID 3[1,2]	Y	2019	√	√	√	√	√	√		
Water User Group										
Alice[1]	Y	2019	√	√	√	√		√	√	
Aransas Pass[2]	Y	2008	√	√		√	√	√	√	
Beeville	Y	2020	√	√	√	√		√		
El Oso WSC	Y	2009	√	√		√		√		√
Falfurrias	Y	1999	√	√		√		√	√	
Holiday Beach WSC	Y	2018	√	√	√	√	√		√	
Ingleside	Y	2018	√	√	√	√		√	√	√
Kingsville[2]	Y	2018	√	√	√	√		√	√	
McCoy WSC[2]	Y	2014	√	√		√		√		
Nueces County WCID 4[1]	Y	2019	√	√	√	√		√	√	
Nueces WSC[1]	Y	2019	√	√		√		√		
Odem[1]	Y	2013	√	√		√		√	√	√
Portland[1]	Y	2015	√	√	√	√	√	√	√	
Ricardo WSC[1]	Y	2018	√	√		√		√		
Robstown[2]	Y	2011						√		
Rockport[2]	Y	2015	√	√	√	√				
Taft[1]	Y	2013	√	√	√	√	√	√	√	
Three Rivers[2]	Y	2019	√	√	√	√		√	√	√

[1] Water Conservation Plan on-file with the Nueces River Authority.

[2] Water Conservation Plan provided by the TWDB.

Table 5C.1.2.
Summary of 5- and 10-Year Water Conservation Goals in the Coastal Bend Region

Wholesale Water Provider	5-Year Goal		10-Year Goal	
	GPCD Target	General	GPCD Target	General
City of Corpus Christi[1,2,3]	195[2]	1% annual reduction over next decade	184[2]	1% annual reduction over next decade
San Patricio Municipal Water District[1]	141	1% annual reduction over next decade	134	1% annual reduction over next decade
South Texas Water Authority[1]	140-145	Not Available	140-145	Not Available
Nueces County WCID 3[1,2]	103	Not Available	108	Not Available
Water User Group				
Alice[1,,2]	176	Reduce per capita use by 3%	173	Reduce per capita use by 3%
Aransas Pass[2]	225	2.5% per capita	260	5% per capita
Beeville	161	1% annual reduction over next decade	160	1% annual reduction over next decade
Corpus Christi[1,2,3]	195	1% annual reduction over next decade	184	1% annual reduction over next decade
El Oso WSC	N/A	Reduce water loss	N/A	Reduce water loss
Falfurrias	N/A	Not Available	N/A	Not Available
Holiday Beach WSC	58	Reduce water loss	56	Reduce water loss
Ingleside	106	1% reduction in water loss and usage within the next 5 years	105	2% within the next 10 years
Kingsville[2]	130	1% annual reduction	125	1% annual reduction
McCoy WSC[1]	115	Maintain current per capita usage; Reduce water loss to 4% of water pumped, line flushing and fire fighting	110	Reduce usage by 4.5%; Reduce water loss to 2% of water pumped, not including line flushing and fire fighting
Nueces County WCID 4[1,2]	396	1% annual reduction over next decade	376	1% annual reduction over next decade
Nueces WSC[1]	118	Maintain current per capita usage	118	Maintain current per capita usage
Odem[1]	149	5% over the next 10 years	146	7% reduction in unaccounted-for water over the next 10 years
Portland[1]	272	5% reduction	258	10% reduction
Ricardo WSC[1]	95	Maintain current per capita usage	95	Maintain current per capita usage
Robstown[2]	N/A	Not Available	N/A	Not Available
Rockport	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands
Taft[1]	147	Reduce per capita use by 3%	140	Reduce per capita use by 3%
Three Rivers[3]	386	0.5% annual reduction	377	0.5% annual reduction

[1] Water Conservation Plan on-file with the Nueces River Authority.
[2] Information is from the 2019 Water Conservation Plans, Target and Goal Table, provided by the TWDB.
[3] Calculated by taking volume of treated water, excluding water sold to wholesale customers, and dividing by permanent population, divided by 365. Because industrial use is close to 40% of treated water, the per capita rate is higher. Target goal for residential use is 73 gpcd (2018) and 69 gpcd (Year 2023).
N/A = Not Available

Table 5C.1.3.
Summary of Water Conservation Implementation Results (2015 and 2016 Annual Reports sent by Utility to TWDB)

Utility Name	Retail Populations	Gallons Conserved	Gallons Reused	Total Meters Tested	Leaks Repaired
City of Alice	19,100	33,000	78,235,890	1	807
City of Beeville	16,266	0	10,700,000	0	300
City of Corpus Christi	324,074	3,261,581,021	0	43	857
City of Portland	20,400	75,260,130	0	2	250
City of Rockport	26,911	314,000,000	184,530,906	1	51
City of Taft	3,400	0	0	11	50
City of Three Rivers	4,413	0	18,635,500	6	22
Nueces County WCID 3	19,000	7,000,000	0	1	0

Table 5C.1.4.
Details on BMPs Implemented

Utility Provider	Total Estimated Gallons Reused	Total Estimated Gallons Saved	Best Management Practices Category							
			Landscaping	Conservation Technology & Reuse	Financial	System Operations	Education and Public Awareness	Regulatory and Enforcement	Retail	Conservation Analysis and Planning
City of Alice	78,235,890	33,000	Golf Course Conservation and Park Conservation	Reuse for Plant Washdown						
City of Beeville	21,400,000			Reuse for On-site Irrigation, Plant Washdown, Chlorination/ Dechlorination						
City of Corpus Christi		3,261,581,021			Water Conservation Pricing	System Water Audit and Loss Control	School Education	Prohibition on Wasting Water		
City of Portland		125,410,130	Landscape Irrigation Conservation and Incentives		Water Conservation Pricing	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control		Prohibition on Wasting Water		
City of Rockport	184,530,906	318,000,000	Golf Course Conservation	Reuse for Chlorination /Dechlorination; Reuse for On-site Irrigation; Reuse for Plant Washdown	Water Conservation Pricing	System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water		
City of Three Rivers	18,635,500								Other	
Nueces County WCID 3		7,000,000	Golf Course Conservation			Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	Public Information	Prohibition on Wasting Water	Other	Cost Effective Analysis
Nueces WSC		Not listed			Water Conservation Pricing	Metering of All Connections; System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water		
Ricardo WSC		Not listed			Water Conservation Pricing	Metering of All Connections; System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water		

Table 5C.1.5.
Summary of Water Conservation Education Program Activities

Utility Name	Population Reached	Education Activity	Number of Times Implemented
City of Alice	19,100	Brochures Distributed	1
		Messages Provided on Utility Bills	1
		Facility Tours	5
City of Corpus Christi	1,630	Brochures Distributed	500
		Press Releases	92
		TV Public Service Announcements	991
		Radio Public Service Announcements	484
		Educational School Programs	8
		Displays, Exhibits, and Presentations	4
		Community Events	4
		Social Media campaign - Facebook	57
		Social Media campaign - Twitter	74
		Social Media campaign - YouTube	13
		Facility Tours	25
City of Portland	20,400	Messages Provided on Utility Bills	6,000
		Other	72,000
City of Rockport	35,400	Brochures Distributed	1
		Messages Provided on Utility Bills	2
		Educational School Programs	1
		Community Events	1
		Facility Tours	1
City of Taft	3,400	Brochures Distributed	1
City of Three Rivers	780	Brochures Distributed	
		Educational School Programs	1
		Displays, Exhibits, and Presentations	
		Community Events	1
		Facility Tours	1
Nueces County WCID 3	N/A	Messages Provided on Utility Bills	
Nueces WSC	N/A	Brochures Distributed	
		Educational School Programs	29
Ricardo WSC	N/A	Brochures Distributed	
		Educational School Programs	29

Table 5C.1.6.
Summary of Rate Structures Implemented to Encourage Conservation

Utility Name	Summary of Implemented Rate Structures
City of Alice	Uniform Rates
City of Beeville	Non-promotional Rates
City of Corpus Christi	Uniform Rates, Water Budget Based Rates, Other
City of Portland	Excess Use Rates, Drought Demand Rates
City of Rockport	Inclining/Inverted Block Rates, Drought Demand Rates
City of Taft	Uniform Rates
City of Three Rivers	Water Budget Based Rates
Nueces County WCID 3	Uniform Rates
Nueces WSC	Inclining Block Rates, Drought Demand Rates
Ricardo WSC	Inclining Block Rates, Drought Demand Rates

5D Water Management Strategy Evaluations

A detailed evaluation of the 11 water management strategies for the 2021 Plan is provided in 5D.1 through 5D.11.

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5D.1

Municipal Water Conservation (N-1)

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5D.1 Municipal Water Conservation (N-1)

5D.1.1 Description of Strategy

Water conservation refers to those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply or use facilities so that existing supply is conserved and made available for future use. Water conservation is typically a low-capital intensive alternative that water supply entities can pursue to extend the life of current water supplies and can even defer development of new water supplies. Water supply entities and some major water right holders are required by Senate Bill 1 regulations to submit a Water Conservation Plan to the TCEQ for approval. These plans must detail the water supply entities' plans to reduce water demand including presenting 5-year and 10-year goals. Information regarding water supply entities that have provided Water Conservation Plans to TCEQ is summarized in Chapter 5C.1.

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter of municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of water conservation is to decrease the amount of water — measured in gallons per person per day (gpcd) — that a typical person uses.

In 2001, the Texas Legislature amended the Texas Water Code to require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). Subsequently, the Water Conservation Implementation Task Force (Task Force) was created by Senate Bill 1094 to identify and describe Water Conservation Best Management Practices (BMPs) and provide a BMP Guide[1] that was used by Regional Water Planning groups for development of 2006 Regional Water Plans. The Task Force recommended that a standardized methodology be used for determining municipal water use based on gallons per capita per day (gpcd) so as to allow consistent evaluations of effectiveness of water conservation measures among Texas cities that are located in the different climates and parts of Texas. The Task Force summarized their recommendations in a Report to the 79th Legislature[2], which included Task Force recommendations of gpcd targets and goals that should be considered by retail public water suppliers when developing water conservation plans required by the state, as follows:

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[1] Texas Water Development Board, Water Conservation Implementation Task Force, Water Conservation Best Management Practices Guide, November 2004. http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R362_BMPGuide.pdf?d=1581280795628

[2] Texas Water Development Board, Water Conservation Implementation Task Force Report to the 79th Legislature, November 2004. https://www.twdb.texas.gov/conservation/resources/doc/WCITF_Leg_Report.pdf

- All public water suppliers that are required to prepare and submit water conservation plans should establish targets for water conservation, including specific goals for per capita water use and for water loss programs using appropriate water conservation BMPs.

- Municipal Water Conservation Plans required by the state shall include per capita water-use goals, with targets and goals established by an entity giving consideration to a minimum annual reduction of 1 percent in total gpcd, until such time as the entity achieves a total gpcd of 140 gpcd or less, or municipal water use (gpcd) goals approved by regional water planning groups.

Since then, the TWDB has continued the work of the Task Force by providing additional resources for municipal water users to assist water utilities with water conservation, including:

- Water Conservation Best Management Practice Guides
  - Municipal Water Providers, May 2019
  - Wholesale Water Providers, October 2017
- Water Conservation Plan Guidance for Utilities, developed in January 2013
  - Water Conservation Plan Checklist
  - How to Develop a Water Conservation Plan
  - Identifying Water Conservation Targets and Goals

The TWDB has provided tools for Regional Water Planning Groups to consider during development of municipal water conservation recommendations for the 2021 Regional Water Plans. These resources were considered during development of the 2021 Region N Regional Water Plan, with Region N-specific results summarized below in sub-bullets.

- Utility-Provided Best Management Practices Implemented as of the 2017 reporting year
  - 5 Region N municipal entities have water conservation BMPs identified in the TWDB document: Alice, Aransas Pass, Portland, Three Rivers, and Nueces County WCID 3.

- Annual Water Conservation Report Data (Years 2015 and 2016)
  - 8 Region N municipal entities submitted annual reports on implementation of their water conservation plan: Alice, Beeville, Corpus Christi, Portland, Rockport, Taft, Three Rivers, and Nueces County WCID #3. The entities range in population size from 3,400 to 324,074.
    - 7 reported that leaks were repaired (2,337 leaks repaired in Region N)
    - 7 reported that they tested meters (65 meters tested in Region N)
    - 5 reported specific conservation savings (gallons)
    - 4 reported specific reuse savings (gallons)
    - Total gallons conserved or reused in Region N = 3.9 Million Gallons (12 acre-feet)

- Municipal Water Conservation Planning Tool
  - The Municipal Water Conservation Planning Tool was developed by the TWDB to assist individual water utilities with planning conservation programs. The tool

allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for many municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs.

- o 11 of the 39 Region N municipal water user groups (or 75 water user groups total after including public water systems aggregated in county other) are included in the Baseline Demand Projection, which includes population, connections, water demands, baseline per capita (gpcd), and water loss. The water demands reflect passive water conservation savings from plumbing codes and appliance standards attributable to state and federal plumbing codes.

Per capita water use from the 2017 State Water Plan was provided by the TWDB for 2021 Regional Water Planning purposes for each municipal WUG based on TWDB-approved population and water demand estimates for each decade from 2020 to 2070. The TWDB provided this information for WUGs based on county, so in some instances one WUG is represented multiple times (i.e. Aransas Pass has three entries for portions located in Aransas, Nueces, and San Patricio Counties). For consistency, Chapter 5D.1 presents information in this way for each WUG and county combination for a total of 54 municipal WUG entries rather than the 50 WUGs reported for Region N including 39 discrete WUGs (i.e. Aransas Pass located in multiple counties counted as 1) and 11 county-other. The historical per capita water use[3] (either 2016, or 2011 if unavailable) was used as a basis for projected per capita water use in decades from 2020 to 2070 that might be expected with implementation of low flow plumbing fixtures. For WUGs with per capita rates lower than 60 gpcd, the TWDB applied a minimum of 60 gpcd in the draft water demand projections and no water efficiency savings were applied to them both in the 2017 State Water Plan and the 2021 draft demand projections. Per capita water use is shown for 54 municipal entities located in the Coastal Bend Region in Table 5D.1.1, in the order of low to high per capita water use in baseline year. The projected savings attributed to plumbing fixture requirements for Region N is 491 ac-ft/yr in 2020 and increases to 961 ac-ft/yr by 2070, shown by WUG in Table 5D.1.2.

[3] Based on water user surveys provided voluntarily by water provider to the TWDB.

Table 5D.1.1.
Municipal Water User Groups Projected Per Capita Water Use (TWDB Projections)

No.	County	Water User	Year 2016 gpcd	2020	2030	2040	2050	2060	2070
1	Jim Wells	Jim Wells FWSD 1	48	60	60	60	60	60	60
2	Jim Wells	Premont	79	217	212	209	208	208	208
3	San Patricio	Ingleside	86	94	91	88	87	87	87
4	Bee	Pettus MUD	89	133	129	125	124	124	124
5	Nueces	Bishop	92	154	149	146	145	145	145
6	Nueces	Violet WSC	93	78	74	71	70	70	70
7	San Patricio	Portland	93	147	143	140	138	138	138
8	Nueces	Driscoll	94	115	111	108	106	106	106
9	San Patricio	Rincon WSC	94	90	88	86	86	85	85
10	Nueces	River Acres WSC	95	143	139	135	134	134	133
11	Kleberg	Kingsville	100	130	126	123	121	121	121
12	Kleberg	Ricardo WSC	107	104	101	98	97	97	97
13	Aransas	County-Other[1]	109	99	95	92	90	90	90
14	Duval	Duval County CRD	115	125	120	117	115	115	115
15	Live Oak	County-Other[1]	118	110	107	105	104	104	104
16	San Patricio	Gregory	119	150	145	143	142	142	142
17	Live Oak	McCoy WSC	123	110	105	105	105	105	105
18	Duval	County-Other[1]	123	113	109	106	104	104	103
19	Brooks	County-Other[1]	124	113	109	106	105	104	104
20	McMullen	County-Other[1]	127	118	114	111	108	108	108
21	Nueces	County-Other[1]	127	117	113	111	109	109	109
22	Duval/ Jim Wells	San Diego MUD 1	128	165	161	158	156	155	155
23	Jim Wells	San Diego MUD 1	128	165	160	158	156	155	155
24	San Patricio	Mathis	130	114	110	106	105	105	105
25	Aransas	Rockport	132	162	159	156	155	155	155
26	Bee	County-Other[1]	133	124	121	118	117	117	117
27	Jim Wells	County-Other[1]	136	127	123	120	119	118	118
28	San Patricio	County-Other[1]	138	126	123	122	122	122	122
29	San Patricio	Odem	142	133	129	126	124	124	124
30	Kleberg	Baffin Bay WSC	145	147	143	140	139	139	138
31	Duval	Freer WCID	148	202	197	194	192	192	192
32	Nueces	Corpus Christi	150	172	168	166	164	164	164
33	Aransas	Aransas Pass	154	127	123	120	118	118	118
34	Nueces	Aransas Pass	154	162	149	137	137	137	137
35	San Patricio	Aransas Pass	154	127	123	120	119	118	118
36	Bee	Beeville	159	193	189	185	184	184	184
37	Jim Wells	Alice	161	178	173	170	169	168	168
38	Kleberg	County-Other[1]	161	150	145	143	143	143	142
39	Nueces	Nueces WSC	164	150	148	146	145	145	145
40	Live Oak	George West	166	164	159	156	154	154	154
41	San Patricio	Taft	167	128	123	120	119	119	119

No.	County	Water User	Year 2016 gpcd	2020	2030	2040	2050	2060	2070
42	San Patricio	Sinton	168	209	205	202	200	200	200
43	Jim Wells	Orange Grove	169	231	227	224	223	222	222
44	Kleberg	Riviera Water System	174	138	134	132	130	130	129
45	Nueces	WCID 3	190	263	259	256	255	255	255
46	Bee	El Oso WSC	192	193	187	184	183	174	174
47	Live Oak	El Oso WSC	192	192	188	185	182	173	173
48	Brooks	Falfurrias	210	243	239	236	234	234	234
49	Live Oak	Three Rivers	223	155	150	147	145	145	145
50	Bee	TDCJ Chase Field	297	267	263	259	258	258	257
51	Nueces	WCID 4	420	454	450	448	446	446	446
52	Kenedy	County-Other[1]	480	470	466	464	463	462	462
53	Nueces	Corpus Christi Naval Air Station	936	1370	1366	1363	1362	1361	1362
54	Kleberg	Naval Air Station Kingsville	2981	4312	4297	4294	4293	4303	4299

[1] Per capita water use is from 2011.

Table 5D.1.2.
Projected Municipal Demand Savings Due to Plumbing Fixture Code Requirements[1]

No.	County	Water User	2020	2030	2040	2050	2060	2070
1	Jim Wells	FWSD 1	0	0	0	0	0	0
2	Jim Wells	Premont	10	15	18	19	19	19
3	San Patricio	Ingleside	9	12	15	16	16	16
4	Bee	Pettus MUD	10	14	17	19	19	19
5	Nueces	Bishop	10	15	18	19	19	19
6	Nueces	Violet WSC	9	13	16	17	17	17
7	San Patricio	Portland	9	13	16	18	18	18
8	Nueces	Driscoll	10	14	17	19	19	19
9	San Patricio	Rincon WSC	7	9	11	11	12	12
10	Nueces	River Acres WSC	10	15	18	19	20	20
11	Kleberg	Kingsville	10	14	17	19	19	19
12	Kleberg	Ricardo WSC	9	12	15	16	16	16
13	Aransas	County-Other	10	14	17	19	19	19
14	Duval	Duval County CRD	10	14	17	19	19	19
15	Live Oak	County-Other	8	11	13	14	14	14
16	San Patricio	Gregory	11	15	18	18	18	18
17	Live Oak	McCoy WSC	9	13	15	16	17	17
18	Duval	County-Other	10	14	17	19	19	19
19	Brooks	County-Other	11	15	18	19	20	20
20	McMullen	County-Other, McMullen	9	13	16	18	19	19
21	Nueces	County-Other	10	14	17	18	18	18
22	Duval	San Diego MUD 1	10	14	17	19	19	19

No.	County	Water User	2020	2030	2040	2050	2060	2070
23	Jim Wells	San Diego MUD 1	10	14	17	19	19	19
24	San Patricio	Mathis	10	14	18	19	19	19
25	Aransas	Rockport	8	11	14	15	15	15
26	Bee	County-Other	9	12	15	16	16	16
27	Jim Wells	County-Other	9	13	16	17	18	18
28	San Patricio	County-Other	12	15	16	16	16	16
29	San Patricio	Odem	10	14	18	19	19	19
30	Kleberg	Baffin Bay WSC	10	13	16	18	18	18
31	Duval	Freer WCID	10	14	17	19	19	19
32	Nueces	Corpus Christi	10	14	16	18	18	18
33	Aransas	Aransas Pass	10	14	17	18	19	19
34	Nueces	Aransas Pass	10	14	17	18	19	19
35	San Patricio	Aransas Pass	10	14	17	18	19	19
36	Bee	Beeville	10	14	18	19	19	19
37	Jim Wells	Alice	10	15	18	19	20	20
38	Kleberg	County-Other	11	16	18	18	18	19
39	Nueces	Nueces WSC	8	10	12	13	13	13
40	Live Oak	George West	9	14	17	19	19	19
41	San Patricio	Taft	10	15	18	19	19	19
42	San Patricio	Sinton	10	14	17	19	19	19
43	Jim Wells	Orange Grove	10	14	17	19	19	19
44	Kleberg	Riviera Water System	10	13	16	18	18	18
45	Nueces	WCID 3	9	13	16	17	17	17
46	Bee	El Oso WSC	0	5	8	10	19	19
47	Live Oak	El Oso WSC	0	5	8	10	19	19
48	Brooks	Falfurrias	11	15	18	19	20	20
49	Live Oak	Three Rivers	9	14	17	19	19	19
50	Bee	TDCJ Chase Field	10	14	17	19	19	19
51	Nueces	WCID 4	9	13	16	17	17	17
52	Kenedy	County-Other	10	13	16	17	18	18
53	Nueces	Corpus Christi Naval Air Station	9	13	16	17	17	17
54	Kleberg	Naval Air Station Kingsville	10	13	16	18	18	18
		Total for Region N	**491**	**706**	**856**	**927**	**960**	**961**

1 Provided by the TWDB by email on May 14, 2018. Spreadsheet can be found at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/project_docs/supportdoc/20170731_Support-Data-WaterEfficiencySavings.xlsx

The purpose of a municipal water conservation WMS is to evaluate the potential of additional municipal water conservation beyond low flow plumbing code for inclusion in the Regional Water Plan to meet a part of the projected water needs (shortages) as required by 31 TAC Chapter 357.22.

The City of Corpus Christi, the largest water user in the Coastal Bend Region, has demonstrated significant water savings attributable to conservation efforts over the last decade. The City's municipal water use was nearly 220 gpcd in 1990[4] and was reduced to 177 gpcd by 2000 and 150 gpcd by 2016, a decrease of about 23 and 32 percent from 1990. Although the most severe portion of the most recent drought lifted in late 2013, many residents have continued to conserve water which is reflected in the low per capita rate in 2016. According to TWDB water use projections, the City of Corpus Christi water use solely attributable to plumbing code savings is anticipated to be 164 gpcd in 2070 (Table 5D.1.1).

During development of this plan, the Coastal Bend Regional Water Planning Group (CBRWPG) gathered and reviewed water conservation plans submitted to the Nueces River Authority and TCEQ by municipal WUGs (and some smaller utilities included in County-Other) in the 11-county Region N. The water conservation plans for Region N municipal WUGs are summarized in Table 5D.1.3 and includes 4 wholesale water providers (City of Corpus Christi, SPMWD, STWA, and Nueces County WCID 3) and 18 municipal water user groups. The purpose of reviewing these plans was to gather information regarding preferred voluntary water conservation BMPs in the Coastal Bend Region and success of the ongoing programs identified previously by the CBRWPG.[5] Additionally, information on goals that water user groups in the region have in the next five and ten years was gathered from the water conservation plans. Based on recent plans filed from 2011 to 2019, local water conservation programs in the Coastal Bend Region have utilized leak detection, water conservation pricing measures, reuse, meter replacement programs, retrofit programs, public education, xeriscaping and other BMPs as shown in Table 5D.1.3 to reduce water use. There are a range of goals included in the water conservation plans. Some user groups want to maintain their current per capita use, some have identified 1%, 2.5%, 3% or 5% reductions over various time periods, and one WUG plans to have a gpcd 10% below the state average. The 5 year and 10 year goals identified in the water conservation plans for Region N municipal WUGS is shown in Table 5D.1.4. This information was used by the Coastal Bend Regional Water Planning Group to develop municipal water conservation goals and prepare a list of most-practical BMPs for voluntary implementation in the region. Additional details on the impact of municipal water conservation BMPs that were implemented based on information provided to the TWDB by the Cities of Alice, Beeville, Corpus Christi, Portland, Rockport, Taft, Three Rivers and Nueces County WCID 3 are included in Chapter 5C discussion summarizing Region N conservation recommendations (Table 5C.1.3. through 5C.1.6).

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[4] City of Corpus Christi Water Conservation Plan, 1999.
[5] Coastal Bend Regional Water Planning Group, 2011 Regional Water Plan, Study 1 – Region-Specific Water Conservation Best Management Practices (BMPs), April 2009.

Table 5D.1.3.
Summary of Water Conservation BMPs in the Coastal Bend Region

Wholesale Water Provider	WCP Available	Date	Best Management Practices							
			Reduce Water Losses/Unaccounted for Water/Leak Detection	Water Conservation Pricing/Seasonal or Inverted Block Rates	Reuse	Improve Meter Accuracy	Toilet Replacement/ Retrofit Programs	Public/School Education	Landscape Conservation/ ~~Xeriscape~~	Others
City of Corpus Christi[1]	Y	2019	√	√	√	√		√	√	√
San Patricio Municipal Water District[1]	Y	2019	√	√	√	√		√	√	√
South Texas Water Authority[1]	Y	2018	√	√		√		√		
Nueces County WCID #3[1,2]	Y	2019	√	√	√	√	√	√		
Water User Group										
Alice[1]	Y	2019	√	√	√	√		√	√	
Aransas Pass[2]	Y	2008	√	√		√	√	√	√	
Beeville	Y	2020	√	√	√	√		√		
El Oso WSC	Y	2009	√	√		√		√		√
Falfurrias	Y	1999	√	√		√		√	√	
Holiday Beach WSC	Y	2018	√	√	√	√	√		√	
Ingleside	Y	2018	√	√	√	√		√	√	√
Kingsville[2]	Y	2018	√	√	√	√		√	√	
McCoy WSC[2]	Y	2014	√	√		√		√		
Nueces County WCID #4[1]	Y	2019	√	√	√	√		√	√	
Nueces WSC[1]	Y	2019	√	√		√		√		
Odem[1]	Y	2013	√	√		√		√	√	√
Portland[1]	Y	2015	√	√	√	√	√	√	√	
Ricardo WSC[1]	Y	2018	√	√		√		√		
Robstown[2]	Y	2011						√		
Rockport[2]	Y	2015	√	√	√	√				
Taft[1]	Y	2013	√	√	√	√	√	√	√	
Three Rivers[2]	Y	2019	√	√	√	√		√	√	√

[1] Water Conservation Plan on-file with the Nueces River Authority.

[2] Water Conservation Plan provided by the TWDB.

Table 5D.1.4. Summary of 5- and 10-Year Goals for Water Conservation in the Coastal Bend Region

Wholesale Water Provider	5-Year Goal		10-Year Goal	
	GPCD Target	General	GPCD Target	General
City of Corpus Christi[1,2,3]	195[2]	1% annual reduction over next decade	184[2]	1% annual reduction over next decade
San Patricio Municipal Water District[1]	141	1% annual reduction over next decade	134	1% annual reduction over next decade
South Texas Water Authority[1]	140-145	Not Available	140-145	Not Available
Nueces County WCID #3[1,2]	103	Not Available	108	Not Available
Water User Group				
Alice[1,2]	176	Reduce per capita use by 3%	173	Reduce per capita use by 3%
Aransas Pass[1]	225	2.5% per capita	260	5% per capita
Beeville	161	1% annual reduction over next decade	160	1% annual reduction over next decade
Corpus Christi[1,2,3]	195	1% annual reduction over next decade	184	1% annual reduction over next decade
El Oso WSC	N/A	Reduce water loss	N/A	Reduce water loss
Falfurrias	N/A	Not Available	N/A	Not Available
Holiday Beach WSC	58	Reduce water loss	56	Reduce water loss
Ingleside	106	1% reduction in water loss and usage within the next 5 years	105	2% within the next 10 years
Kingsville[2]	130	1% annual reduction	125	1% annual reduction
McCoy WSC[1]	115	Maintain current per capita usage; Reduce water loss to 4% of water pumped, line flushing and fire fighting	110	Reduce usage by 4.5%; Reduce water loss to 2% of water pumped, not including line flushing and fire fighting
Nueces County WCID #4[1]	396	1% annual reduction over next decade	376	1% annual reduction over next decade
Nueces WSC[1]	118	Maintain current per capita usage	118	Maintain current per capita usage
Odem[1]	149	5% over the next 10 years	146	7% reduction in unaccounted-for water over the next 10 years
Portland[1]	272	5% reduction	258	10% reduction
Ricardo WSC[1]	95	Maintain current per capita usage	95	Maintain current per capita usage
Robstown[3]	N/A	Not Available	N/A	Not Available
Rockport	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands
Taft[1]	147	Reduce per capita use by 3%	140	Reduce per capita use by 3%
Three Rivers[2]	386	0.5% annual reduction	377	0.5% annual reduction

[1] Water Conservation Plan on-file with the Nueces River Authority.

[2] Information is from the 2019 Water Conservation Plans, Target and Goal Table, provided by the TWDB.

[3] Calculated by taking volume of treated water, excluding water sold to wholesale customers, and dividing by permanent population, divided by 365. Because industrial use is close to 40% of treated water, the per capita rate is higher. Target goal for residential use is 73 gpcd (2018) and 69 gpcd (Year 2023).

N/A = Not Available

Public information and education can work to conserve water by informing water users of ways to manage and operate existing and new fixtures and appliances so that less water is used. This includes ideas and practices such as washing full loads of clothes and dishes; using a pail of water instead of a flowing hose to wash automobiles; turning the water off while brushing one's teeth, washing one's hands, or shaving; and watering lawns, gardens, and shrubs during evening — as opposed to daytime — hours.

The Coastal Bend Regional Water Planning Group recommends that water user groups, with and without shortages, above 140 gallons per capita per day (gpcd) reduce consumption by 1 percent each year until a target per capita rate of 140 gpcd is met and then hold the 140 gpcd rate constant through the remaining planning period. For entities with projected water use equal or less than 140 gpcd in 2020, TWDB projections are recommended. All water user groups in the region are encouraged to voluntarily conserve water.

In 2020, 25 municipal water users in the Coastal Bend Water Planning Region have per capita water use of less than 140 gpcd. Water users with 140 gpcd or less represents 26 percent of the population of the Region in 2020, and uses 19 percent of the total municipal water in the Region (Table 5D.1.5). In 2020, 29 municipal water users have per capita water use greater than 140 gpcd. This group represents 74 percent of the region's population in 2020 and accounts for 81 percent of the municipal water used in the Region (Table 5D.1.5).

Table 5D.1.5.
Municipal Water User Groups Number, Population, and Water Use by Per Capita Water Use Levels Coastal Bend Water Planning Region

Per Capita Water Use in 2020 (gpcd)	Number of WUGs	Percent of WUGs	Population		Water Use	
			2020 (number)	Percent of Total	2020 (ac-ft)	Percent of Total
140 and less	25	46.30%	160,092	26.04%	21,968	19.04%
Greater than 140	29	53.70%	454,698	73.96%	93,398	80.96%
Totals	54	100%	614,790	100%	115,366	100%

5D.1.2 Available Yield

All municipal entities in the Coastal Bend Region are encouraged to conserve water, regardless of per capita consumption.

Of the 54 municipal entities in Region N, 29 had per capita water use rates equal to or higher than 140 gpcd, the goal established by the CBRWPG. The CBRWPG recommends a 1 percent reduction per year in water use for those municipal entities with per capita use greater than 140 gpcd until a target goal of 140 gpcd is reached. This conservation can be achieved in a variety of ways, including using these BMPs identified by the TWDB[6]:

[6] https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp

1. System Water Audit and Water Loss,
2. Water Conservation Pricing,
3. Prohibition on Wasting Water,
4. Conservation Ordinance Planning and Development,
5. Showerhead, Aerator, and Toilet Flapper Retrofit,
6. Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,
7. Residential Clothes Washer Incentive Program,
8. School Education,
9. Water Survey for Single-Family and Multi-Family Customers,
10. Landscape Irrigation Conservation and Incentives,
11. Water-Wise Landscape Design and Conversion Programs,
12. Athletic Field Conservation,
13. Golf Course Conservation,
14. Metering of all New Connections and Retrofitting of Existing Connections,
15. Wholesale Agency Assistance Programs,
16. Conservation Coordinator (updated 2019),
17. Water Reuse[7],
18. Public Information,
19. Rainwater Harvesting and Condensate Reuse[8],
20. New Construction Greywater,
21. Park Conservation,
22. Conservation Programs for Industrial, Commercial, and Institutional Accounts,
23. Residential Landscape Irrigation Evaluation,
24. Outdoor Watering Schedule (adopted 2019),
25. Custom Characterization (adopted 2019),
26. Public Outreach and Education (adopted 2019),
27. Partnerships with Nonprofit Organizations,
28. Custom Conservation Rebates (adopted 2019),
29. Plumbing Assistance for Economically Disadvantaged Customers (adopted 2019)

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5D.1.6. Costs and savings presented are general and often sparse, based on a range of variables affecting implementation and level of success. For this reason and others, specific municipal water conservation BMPs are not assigned to municipal entities to provide flexibility for entities to identify practical conservation strategies that fit their individual situation the best.

A description of indoor, landscape irrigation, and water loss reduction and meter replacement methods are discussed below to assist municipal entities achieve water conservation savings.

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[7] Water Reuse to read "It is assumed that any savings associated with reuse is a small contribution to the savings identified on Table 5D.1.8 and does not duplicate reuse projects identified in Section 5D.5

[8] While the municipal conservation best practices guide includes rainwater harvesting and reuse, for regional water planning purposes these practices are considered separate sources and not classified as 'conservation'.

Table 5D.1.6.
Costs and Savings of Possible Municipal Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/ Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric Metric	
1	Water Conservation Pricing/Seasonal or Inverted Block Rates	1	3	2	%	-	-	10	%	Average reduction in water use of 1 to 3% for every 10% increase in the average monthly water bill
2	Metering of All New Connections and Retrofit of Existing Connections	-	-	-	-	-	-	-	-	
3	System Water Audit and Water Loss Control	-	-	-	-	-	-	-	-	
4	Landscape Irrigation Conservation and Incentives	-	-	15	%	-	-	-	-	
5	Athletic Field Conservation	-	-	-	-	-	-	-	-	
6	Golf Course Conservation	15	100	57.5	%	-	-	-	-	Savings and costs highly variable based measures taken - from implementing a CCIS to switching from potable to non-potable water
7	School Education	-	-	-	-	$1	$35	$18	per student	
8	Public Information	-	-	-	-	$0.50	$3.00	$1.75	per customer	
9	Water Reuse	-	100	-	%	-	-	-	-	
10	Prohibitions on Wasting Water	-	-	-	-	-	-	-	-	
11	Residential Toilet Replacement Programs	-	-	10.5	gpcd	$70	$100	$85	per toilet	
12	Showerhead, Aerator, and Toilet Flapper Retrofit	5.5	12.8	9.15	gpd per device	10	50	$30.00	per customer	5.5 gpd of permanent savings for showerheads and faucet aerators; 12.8 gpd for toilet flapper for 5 years (device life span)
13	Water Wise Landscape Design and Conversion Programs	-	-	-	-	0.05	1	$0.53	per sq ft	Costs reflect customer rebates - does not include staff labor cost, which ranges between $50 to $100 per conversion

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/ Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric Metric	
14	Custom Conservation Rebates	-	-	-	-	-	-	-	-	
15	Plumbing Assistance for Economically Disadvantaged Customers	300	262,080	131,190	gal/yr	-	-	-	-	
16	Rainwater Harvesting and Condensate Reuse	-	-	-	-	-	-	-	-	

Source TWDB: https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp

5D.1.2.1 Indoor Water Conservation

In 2009, the Texas Legislature enacted House Bill (HB) 2667 establishing new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 clarifies and sets out the national standards of the American Society of Mechanical Engineers and American National Standards Institute by which plumbing fixtures will be produced and tested. This bill establishes a phase-in of high efficiency plumbing fixtures brought into Texas, which will allow manufacturers the time to change their production, at the same time allowing retailers the opportunity to turn over their inventory. The TCEQ has promulgated rules to reflect this new change in law. The 2009 law requires that by January 2014, all toilets use no more than 1.28 gallons per flush (20% savings from the 1991 1.6 gallons per flush standard), as shown in Table 5D.1.7.

Table 5D.1.7.
Standards for Plumbing Fixtures

Fixture	Standard
Toilets*	1.28 gallons per flush
Shower Heads	2.75 gallons per minute at 80 psi
Urinals	0.5 gallon per flush
Faucet Aerators	2.20 gallons per minute at 60 psi
Drinking Water Fountains	Shall be self-closing

* House Bill 2667 of the 81st Texas Legislature, 2009

Based upon an average frequency of per-person toilet use of 5.1 and a per-use savings of 0.32 gallons per use, the supplementary savings of adopting high-efficiency toilets is 1.63 gpcd. The water savings potential with the plumbing efficiency program is shown in Table 5D.1.8.

Table 5D.1.8.
Water Conservation Potentials of Low Flow Plumbing Fixtures

Plumbing Fixture	Water Savings (gpcd)
Toilets and Showerheads	16.0
Additional Savings (High Efficiency Toilet)*	1.63
Faucet Aerators – 2.2 gallons per minute	2.0
Urinals – 1.0 gallon per minute	0.3
Drinking Fountains (self-closing)	0.1
Total	20.03 (~20 gpcd)

* TWDB, 2013

The TWDB water demand and per capita projections for the 2021 Region N Plan already includes water savings through mandated plumbing fixture replacement programs, and much of the savings reported in Table 5D.1.8 have likely been realized. The target water conservation goals recommended by the Coastal Bend Region for WUGs exceeding 140 gpcd are to be achieved with additional BMPs for the desired water savings above the amount already included in TWDB projections.

5D.1.2.2 Outdoor Water Conservation

In addition to the indoor water conservation measures described above, the water conservation WMS for municipal entities for the Coastal Bend Region includes landscape irrigation and lawn watering. Unlike indoor water conservation, no limit was assumed for the savings potentials associated with outdoor conservation. Instead, outdoor water conservation can be used to meet the projected water savings that is needed to meet the Region N municipal water goals.

5D.1.2.3 Water Loss Reduction and Meter Replacement

A municipality can determine unaccounted for water losses by performing a water audit, which includes collecting information that can then be used to calculate unaccounted for water loss using the following equation:

Unaccounted for water = Water production/purchased (gallons) – Water sales (gallons)

To maximize the benefits of this conservation strategy, the utility uses this audit information to revise meter testing and repairs, reduce unmetered use, improve accuracy of the utility's metering system, and implement effective water loss management strategies. Factors that affect the amount of unaccounted for water include density of the system, age of the system, construction quality of the system, and accuracy of the water metering.

In December 2004, the TWDB adopted rules to require retail public utilities, as defined by Texas Water Code §13.002, to perform a water loss audit and submit water loss audit forms to the TWDB every five years.[9] Pursuant to TWDB Rules[10] for regional water planning, RWPGs are

[9] In accordance with Texas Administrative Code §358.6.
[10] In accordance with Texas Administrative Code §357.7(a)(1)(M) and Texas Administrative Code §357.7(a)(7)(a)(iv)

required to include information compiled by the TWDB from water loss audits performed by retail public utilities and consider strategies to address any issues identified in the water loss audit information compiled by the TWDB. The CBRWPG presented this information in Chapter 1.

The TCEQ reports that unaccounted for water losses of 15 percent or less are acceptable for communities greater than 5,000 people. Losses above 15 percent may be an area of concern and provide conservation potentials. Of the 34 entities in the Coastal Bend Region that responded to the 2015-2017 Water Loss Survey (23 from individual municipal entities and eleven from County-Other entities), 6 reported water losses exceeding 15%. Based on this information, these utilities may want to consider pipeline replacement programs.[11] Pipeline replacement programs are intended to address real losses, that is, those losses primarily associated with breaks, leaks, and unreported losses. Estimated costs for a 10-year pipeline replacement program was prepared for these 6 entities as shown in Table 5D.1.9. Pipeline cost was based on the Unified Costing Model cost and following assumptions:

- Entities with less than 32 connections: pipeline costs based on 12" rural, soil environment of $68 per ft ($360,529 per mile)
- Entities with greater than 32 connections: pipeline costs based on 16" urban, soil environment of $125 per ft ($660,449 per mile)
- Pipeline replacement of 10% each year. Full replacement after 10 years.

In addition to unaccounted for water losses, public information programs can be an important and key element to having water users save water inside homes and commercial structures, in land-scaping and lawn watering, and in recreation uses. Public information and education can work in two ways to accomplish water conservation. One way is to inform and convince water users to obtain and use water-efficient plumbing fixtures and appliances, to adopt low water use land-scaping plans and plants, to find and repair plumbing leaks, to use gray water for permissible uses (e.g., lawn and shrubbery watering where regulations allow), and to take advantage of water conservation incentives where available.

The accurate metering of consumed water encourages personal accountability, water conser-vation and equity in billing rates. Meter replacement programs can be an effective measure for reducing apparent loss, or water that has been consumed but not properly measured or billed. The 2015-2017 Water Loss Surveys reported an overall customer meter accuracy of 97% and apparent loss in the Coastal Bend of 2.8% based on responses from 34 entities. Two of the 34 entities in Coastal Bend that responded to the survey reported apparent losses greater than 5%. Based on this information, these utilities may want to consider meter replacement programs. The majority of meters used in residential systems are between 5/8 and 1-inch with ± 1.5% accuracy and the cost averages about $120 per meter (cost of material only, does not include automatic meter reading)[12]. Estimated costs for meter replacement program for entities reporting apparent losses greater than 5% is shown in Table 5D.1.10. After considering demand reductions already

[11] Meter retrofits can also achieve water savings, but due to high cost variability based on individual systems this best practice was not explored in detail.
[12] Seametrics MJN Pulse Water Meter ¾" $116/each and Assured Automation inline, multi-jet ½" $117/each, internet October 2015.

incorporated into the TWDB demand projections, a 1 percent reduction in per capita water use per year for those cities and county-others using greater than 140 gpcd in 2020 results in a water savings (yield) — less water used — of 14,689 ac-ft in 2040 and 18,793 ac-ft in 2070, as seen in Table 5D.1.11. Note: Water savings are only included for 29 of the 54 municipal entities, since 25 of the entities had a water use equal or less than 140 gpcd in 2020.

Table 5D.1.9.
Summary of Estimated Pipeline Replacement Costs for Entities Reporting Losses Greater than 15%

Utility Name	Retail Pop Served	Main Line Miles	Real Loss/In-put Volume*	Total 10 year water savings needed to achieve 5% Real Loss (gallons)	Annual Water Savings Needed to Achieve 5% Real Loss in 10 years (gallons)	Amount of Pipe (miles) to be replaced annually to achieve 100% replacement in 10 years	Annual Cost ($)	Cost 10 Year Program ($)	Amortized Annual Cost of 10-Year Program ($)	Unit Cost ($ per acft saved)
Aransas Bay Utilities	600	10	29%	4,880,129	488,013	1	$660,449	$6,604,490	$876,203	$585,049
Aransas County MUD 1	435	20	16%	1,518,049	151,805	2	$1,320,898	$13,208,980	$1,752,406	$3,761,561
City of Alice	19,010	100	16%	118,217,253	11,821,725	10	$6,604,490	$66,044,900	$8,762,030	$241,514
City of Aransas Pass	8,393	65	20%	83,571,713	8,357,171	7	$4,292,919	$42,929,185	$5,695,319	$222,064
City of Mathis	5,037	36	26%	40,601,894	4,060,189	4	$2,377,616	$23,776,164	$3,154,331	$253,151
Duval County CRD	2,525	20	17%	7,492,115	749,212	2	$1,320,898	$13,208,980	$1,752,406	$762,166

*Note: The percentage shown is attributable to real losses, which can be addressed with pipeline replacement programs. These percentages will differ from water loss survey information, which reports total water loss (apparent and real loss).

Table 5D.1.10.
Summary of Estimated Meter Replacement Costs for Entities Reporting Apparent Losses Greater than 5%

Utility Name	No. of Retail Service Connections	System Input Volume (gallons)	Total Apparent Loss (gallons)	Apparent Loss (%)	Number of Meters to be Replaced Annually to Achieve 100% replacement in 10 years	Annual Cost ($120 per meter; 10 year program)"	Total 10 Year Program Meter Replacement Cost	Amortized Annual Cost of 10-Year Program ($)
Aransas Bay Utilities	270	20,359,523	3,940,134	19%	27	$3,240	$32,400	$4,298
Copano Heights Water	98	4,645,327	304,652	7%	9.8	$1,176	$11,760	$1,560

5D.1.3 Environmental Issues

Environmental impacts from water conservation measures in the Coastal Bend Region are not associated with direct physical impacts to the natural environment. Some of the indoor conservation measures recommended could reduce the amount of treated wastewater available to send to the Nueces Bay and Estuary during low flow times, which could be offset by possible positive impact resulting from higher reservoir levels.

Under a 2001 Agreed Order from the TCEQ[13], the City of Corpus Christi is required to pass specified volumes of inflows to the reservoirs in accordance with a monthly schedule to mitigate the impacts of Choke Canyon Reservoir and maintain the health of the Nueces Estuary. In any month when the System storage is less than 40 percent but greater than 30 percent, the target Nueces Bay inflow requirement may be reduced to 1,200 ac-ft/mo when the City of Corpus Christi and its customers implement Condition II of the City's Water Conservation and Drought Contingency Plan (Plan). If System storage drops below 30 percent, bay and estuary releases (except for return flows) may be suspended when the City and its customers implement Condition III of the Plan. The City of Corpus Christi's water conservation and drought contingency plan is summarized in Chapters 5C and 7.

[13] Texas Commission on Environmental Quality (TCEQ), Agreed Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, Held by City of Corpus Christ, et al., April 28, 1995.

Table 5D.1.11. Potential Additional Water Conservation Savings for Water User Groups Having 2020 per Capita Water Use Greater than 140 gpcd

WUG Name	County	Housing Area	2030		2040		2050		2060		2070	
			gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr
Rockport	Aransas	Suburban	12	270	16	353	15	327	15	321	15	321
Beeville	Bee	Suburban	14	254	27	502	41	757	44	806	44	806
El Oso WSC	Bee	Rural	12	7	26	14	40	22	34	19	34	19
TDCJ Chase Field	Bee	Rural	21	85	41	167	61	247	79	322	96	391
Falfurrias	Brooks	Rural	19	132	37	266	55	406	71	546	87	688
Freer WCID	Duval	Rural	15	54	29	110	43	170	52	211	52	215
San Diego MUD 1	Duval	Rural	11	55	17	88	16	83	15	84	15	87
Alice	Jim Wells	Suburban	13	345	25	725	29	899	28	938	28	981
Orange Grove	Jim Wells	Rural	18	40	35	83	52	131	67	181	82	232
Premont	Jim Wells	Rural	16	58	32	120	48	194	63	268	68	302
San Diego MUD 1	Jim Wells	Rural	11	13	18	21	16	19	15	19	15	20
County-Other, Kenedy	Kenedy	Rural	41	23	79	45	115	65	147	84	178	101
County-Other, Kleberg	Kleberg	Rural	5	10	3	6	3	6	3	6	2	6
Naval Air Station Kingsville	Kleberg	Rural	397	26	767	54	1,103	84	1,418	114	1,690	144
El Oso WSC	Live Oak	Rural	14	13	27	25	40	37	33	30	33	30
George West	Live Oak	Rural	11	30	16	42	14	39	14	38	14	38
Three Rivers	Live Oak	Rural	10	37	7	24	5	18	5	17	5	17
Bishop	Nueces	Rural	10	43	6	26	5	23	5	22	5	22
Corpus Christi	Nueces	Urban	12	5,028	25	10,439	24	10,550	24	10,648	24	10,779
Corpus Christi Naval Air Station	Nueces	Rural	127	109	243	220	349	325	445	423	533	515
Nueces County WCID 3	Nueces	Suburban	21	328	41	638	61	936	79	1,219	96	1,477
Nueces County WCID 4	Nueces	Rural	39	233	76	473	110	706	142	929	171	1,134
Nueces WSC	Nueces	Rural	8	31	6	28	5	29	5	30	5	35
Gregory	San Patricio	Rural	5	11	3	6	2	6	2	4	2	4
Sinton	San Patricio	Rural	16	106	31	211	45	319	60	427	60	430
Total				**7,341**		**14,689**		**16,399**		**17,707**		**18,793**

5D.1.4 Engineering and Costing

Municipal water conservation costs were based on the TWDB Municipal Water Conservation Planning Tool developed to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs. The tool includes the following pre-defined BMPs HE Toilet Rebate.

- Bathroom Retrofit
- Showerhead and Aerator Kit
- Clothes Washer Rebate
- Home Water Reports
- Irrigation Audits- High Users
- High Efficiency Sprinkler Nozzle Rebate
- Smart Irrigation Controller Rebate
- WaterWise Landscape Rebate
- Rainwater Harvesting Rebate, and
- Rain Barrel

The costs to implement these BMPs ranges from $243 to $1,409 per ac-ft saved, with the showerhead kit being the most economical ($243 per ac-ft saved) and clothes washer rebates and rain barrels being the most expensive at $1,220 and $1,409 per ac-ft, respectively. Since the TWDB tool only included 11 of the 39 Region N individual, discrete municipal water user groups (or 75 water user groups total after including county other public water systems), three Region N water user groups were selected to represent a range of Small, Medium and Large utilities for costing purposes in accordance with the CBRWPG municipal water conservation methodology adopted at its meeting on May 9, 2019.

The City of Taft records in the TWDB tool was considered representative of “Small” Region N municipal water users; the City of Portland was considered representative of “Medium” Region N municipal water users (populations less than 10,000); and the City of Corpus Christi information was obtained from the TWDB tool. As shown in 5D.1.11, 20 of the 25 entities with per capita rates exceeding 140 gpcd for which additional conservation is recommended are categorized as “Small”; 4 categorized as “Medium”; and 1 categorized as “Large”. Although the TWDB tool did not present costs for the most common water conservation BMPs from local water conservation plans in the Coastal Bend Region (Table 5D.1.3), the following BMPs from the TWDB tool were selected to estimate a unit cost for municipal water conservation: HE Toilet Rebate, Bathroom Retrofit, Showerhead and Aerator Kit, Home Water Reports, and WaterWise Landscape Rebate. The costs to implement these BMPs according to the program rates identified in the TWDB tool ranged from $498 to $503 per ac-ft water saved.

The total program costs for municipal entities having per capita use greater than 140 gpcd in 2020 are presented in Table 5D.1.12. Total conservation potential costs for Region N are estimated at $7,371,277 in 2040 and increasing to $9,421,807 by 2070. The CBRWPG has expressed a desire to recommend BMPs to encourage conservation while maintaining flexibility for municipal users to adopt strategies that suit them the best.

These annual costs have been capitalized over a 20 year period at 3.5% interest rate by assuming that 70% of the annual costs for a municipal water conservation program are associated with repayment of debt issued to fund the initial capital expenditures. Capital costs are also shown in Table 5D.1.12.

5D.1.5 Implementation Issues

There are several issues that may slow down the efforts of water conservation activities. The most crucial is to get water customers to change their water use habits. Effective public out-reach and education can go a long way to reducing water use, but in the end the effectiveness of any program is dependent upon the individual. A key element to the Drought Contingency and Water Conservation Plan that each city has been required to submit to the TCEQ is the curtailment of water use during drought. Enforcement of these restrictions — usually ones that limit lawn watering — is often difficult. Lastly, capital costs for retrofit programs can be large depending on the system, and may be difficult for cities or rural entities to initially finance.

5D.1.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.1.13.

Table 5D.1.12.
Cost of Water Conservation for Selected Water Conservation Techniques for Water User Groups Having 2020 per Capita Water Use Greater than 140 gpcd

WUG Name	County	Housing Area	Cost per acft	2030	2040	2050	2060	2070
Rockport	Aransas	Suburban	$498	$134,659	$176,002	$162,940	$159,796	$159,796
Beeville	Bee	Suburban	$498	$126,376	$249,879	$377,062	$401,140	$401,169
El Oso WSC	Bee	Rural	$500	$3,328	$7,132	$11,119	$9,344	$9,344
TDCJ Chase Field	Bee	Rural	$500	$42,623	$83,544	$123,331	$160,986	$195,701
Falfurrias	Brooks	Rural	$500	$65,765	$132,887	$203,058	$273,171	$344,021
Freer WCID	Duval	Rural	$500	$26,957	$55,153	$84,895	$105,332	$107,588
San Diego MUD 1	Duval	Rural	$500	$27,496	$43,773	$41,512	$41,918	$43,284
Alice	Jim Wells	Suburban	$498	$171,844	$361,080	$447,512	$467,259	$488,694
Orange Grove	Jim Wells	Rural	$500	$19,957	$41,730	$65,573	$90,448	$115,863
Premont	Jim Wells	Rural	$500	$28,963	$60,021	$96,825	$134,128	$151,144
San Diego MUD 1	Jim Wells	Rural	$500	$6,307	$10,356	$9,671	$9,613	$10,025
County-Other, Kenedy	Kenedy	Rural	$500	$11,325	$22,379	$32,681	$41,953	$50,515
County-Other, Kleberg	Kleberg	Rural	$500	$5,134	$3,078	$2,836	$2,956	$2,860
Naval Air Station Kingsville	Kleberg	Rural	$500	$13,134	$27,055	$42,022	$57,175	$71,953
El Oso WSC	Live Oak	Rural	$500	$6,510	$12,706	$18,667	$15,155	$15,155
George West	Live Oak	Rural	$500	$15,214	$20,776	$19,276	$18,776	$18,776
Three Rivers	Live Oak	Rural	$500	$18,399	$12,165	$9,165	$8,665	$8,665
Bishop	Nueces	Rural	$500	$21,384	$13,015	$11,655	$11,069	$11,099
Corpus Christi	Nueces	Urban	$503	$2,529,087	$5,250,958	$5,306,806	$5,356,195	$5,421,820
Corpus Christi Naval Air Station	Nueces	Rural	$500	$54,653	$110,142	$162,696	$211,678	$257,327
Nueces County WCID 3	Nueces	Suburban	$498	$163,195	$317,761	$466,100	$606,821	$735,390
Nueces County WCID 4	Nueces	Rural	$500	$116,713	$236,691	$353,151	$464,583	$566,878
Nueces WSC	Nueces	Rural	$500	$15,439	$14,165	$14,355	$15,222	$17,749
Gregory	San Patricio	Rural	$500	$5,535	$3,144	$2,851	$2,156	$2,166
Sinton	San Patricio	Rural	$500	$53,019	$105,683	$159,676	$213,516	$214,823
Total Region N Cost of Water Conservation Programs to Achieve Savings Goals ($)				**$3,683,015**	**$7,371,277**	**$8,225,433**	**$8,879,055**	**$9,421,807**

Table 5D.1.13. Evaluation Summary of Municipal Water Conservation

Impact Category	Comment(s)
a. Water Supply	1. Firm Yield: 7,341 ac-ft/yr in 2020 to 18,793 ac-ft/yr in Year 2070. 2. Highly reliable. 3. Unit Cost ranges from $498 to $503 per ac-ft water saved
1 Quantity	
2. Reliability 3. Cost of Treated Water	
b. Environmental factors	
1. Instream flows	1. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
3. Wildlife Habitat	3. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
4. Wetlands	4. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	
c. Impacts to agricultural resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• May be some impact to disinfectant chlorine residuals.

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5D.2

Irrigation Water Conservation (N-2)

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5D.2 Irrigation Water Conservation (N-2)

5D.2.1 Description of Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs and applied directly to grow cotton, corn, sorghum, and other crops in the study area. The amount of water supplied to irrigate agriculture accounted for around 54 percent of approximately 13.75 million ac-ft of water used in the state in 2017.[1] Approximately 7.49 million ac-ft of water were used in Texas to irrigate 5.75 million acres to grow a variety of crops ranging from food and feed grains to fruits and vegetables to cotton. Of these 7.49 million ac-ft, groundwater resources provide approximately 74 percent of the water used for irrigation purposes, with surface water supplies accounting for the remaining 26 percent.

In Texas, irrigated acreage development peaked in 1974 with 8.6 million acres of irrigated cropland. By 2017, irrigated acreage had declined statewide by approximately 2.85 million acres, with a corresponding decline in on-farm water use of more than 5.5 million ac-ft, a reduction of 43 percent.[2,3] There are a number of factors associated with this declining trend, including more acreage being set aside for compliance with federal farm programs, poor economic conditions in the agricultural sector, a decline in the number and size of farms, technological advancements in crop production, advancement and implementation of more water efficient irrigation systems, and better irrigation management practices.

Within the past twenty years, statewide irrigated acreage peaked in 2003 with approximately 5.8 million acres of irrigated cropland, yet corresponding water use declined in comparison to previous years. On-farm water use in Texas was highest in 2011 with 9.3 million ac-ft, over 1.6 million acres more than in 2003.[3] This spike in water use was likely caused by the intensity of the 2011 drought.

Irrigation water is supplied by groundwater and surface water and is typically applied to land by: 1) flowing or flooding water down the furrows; and 2) with the use of sprinklers. When groundwater is used, irrigation wells are usually located within the fields to be irrigated. For surface water supplies, typically water is diverted from the source and conveyed by canals and pipelines to the fields. In both the use of groundwater and surface water, the conservation objective is to reduce the quantity of water that is lost to deep percolation and evaporation between the originating points (wells in the case of groundwater, and stream diversion points in the case of surface water), and the irrigated crops in the fields. Thus, the focus is upon investments in irrigation application equipment, instruments, and conveyance facility improvements (canal lining and pipelines) to reduce seepage losses, deep percolation, and evaporation of water

[1] Texas Water Development Board (TWDB) Historical Water Use Database, 2019. http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/2017TexasWaterUseEstimatesSummary.pdf?d=74490.57500000345
[2] 2017 Census of Agriculture.
[3] TWDB, Historical Water Use Database, 2012.

between the originating points of the water and the destination locations within the irrigated fields, and management of the irrigation processes to improve efficiencies of irrigation water use and reduce the quantities of water needed to accomplish irrigation.

Although the statewide trend in irrigated acreage is downward, irrigated acreage in the Coastal Bend Region does not reflect this trend. Crops grown on irrigated acres in the Coastal Bend Region included cotton, grain sorghum, corn, forage crops, hay-pasture, Irish potatoes, vegetables, and other crops. The 2017 agricultural census indicates that irrigated acreage in the 11-county Coastal Bend area totaled 25,550 acres, with 82 percent of the regional total occurring in Bee, Jim Wells, and San Patricio counties. Table 5D.2.1 summarizes the variety of crops grown in the Coastal Bend Region and number of irrigated acres for each county in 2017.

Table 5D.2.1.
Irrigated Acres by Crop (2017) Coastal Bend Region

	Corn	Cotton	Hay	Sorghum	Vegetables	Other[1]	Total
Aransas	0	0	0	0	0	0	0
Bee	2,230	2,020	200	2,160	0	630	7,240
Brooks	0	0	340	0	200	60	600
Duval	0	0	520	0	1,110	40	1,670
Jim Wells	0	0	600	0	600	540	1,740
Kenedy	0	0	0	0	0	0	0
Kleberg	0	0	330	0	0	0	330
Live Oak	420	280	730	110	0	0	1,540
McMullen	0	0	0	0	0	0	0
Nueces	10	10	20	20	0	280	340
San Patricio	3,680	5,640	10	2,590	150	20	12,090
Total	**6,340**	**7,950**	**2,750**	**4,880**	**2,060**	**1,570**	**25,550**
Percent	**24.81%**	**31.12%**	**10.76%**	**19.10%**	**8.06%**	**6.14%**	**100%**

Source: USDA National Agricultural Statistics Service 2017 Census (http://quickstats.nass.usda.gov/?source_desc=CENSUS)

In 2010, the irrigators in the Coastal Bend Region used 18,398 ac-ft of water to irrigated 27,336 acres, of which nearly 99 percent was from groundwater sources. In 2017, the TWDB estimated that the irrigators in the 11- county Coastal Bend used 14,405 ac-ft.

On June 2, 2017 the TWDB provided draft irrigation water demand projections for Coastal Bend Regional Water Planning Group review and comment. A Region N subcommittee comprised of six Region N members was formed at the August 10, 2017 RWPG meeting to review TWDB draft irrigation and other non-municipal water demand projections. The subcommittee met on September 7, 2017 to discuss TWDB draft projections and local data pertinent to demand projections. At the subcommittee's request, based on local feedback and data, alternative demand projections were prepared for all counties with projected irrigation water demands in which 2020 was set equal to the highest year of recent historic use (Year 2011) and 2030-2070 were kept constant and equal to 2020 water demands. These alternative irrigation water demand projections were subsequently approved by the TWDB. The final TWDB-adopted projections based on the feedback from the Coastal Bend Regional Water Planning Group resulted in a region-wide irrigation water demand increase of 26% (or 5,328 ac-ft more) as compared to initial, TWDB draft irrigation projections. The irrigation water demand projections for the Coastal Bend Region show no increases in irrigation usage in the future, with demands remaining at 25,837 ac-ft/yr from 2020 through 2070.

In the Coastal Bend Region, the majority of irrigation water supply is provided from groundwater sources. Live Oak County irrigators receive some of their water supply from run-of-river water rights from the Nueces River through the City of Three Rivers water right.

Groundwater availability was based on current MAG values set by the GCD and GMA process. Existing groundwater supplies were based on TCEQ reported well capacity, when available. In most cases, however, irrigation well capacity information was not publicly available. For this reason, irrigation groundwater supplies were calculated based on highest use from recent TWDB historical water use records (2012-2015).

In the Coastal Bend Region, Bee, Jim Wells, Live Oak, Nueces, and San Patricio Counties are projected to have irrigation needs (shortages) during the 2020 to 2070 planning period, as shown in Table 5D.2.2. Aransas, Kenedy, and McMullen Counties show no irrigation water demand during the planning period from 2020 to 2070.

TWDB rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The TWDB has provided information on irrigation water conservation BMPs, for consideration in the development of the water conservation WMS including a Best Management Practice Guides for Agricultural Water Users.

Table 5D.2.2. Projected Water Demands, Supplies, and Water Needs (Shortages) for Irrigation Users in Bee, Jim Wells, Live Oak, Nueces and San Patricio Counties

	Projections (ac-ft/yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Bee County						
Irrigation Demand	4,425	4,425	4,425	4,425	4,425	4,425
Irrigation Existing Supply						
Groundwater	4,073	4,073	4,073	4,073	4,073	4,073
Surface Water	0	0	0	0	0	0
Total Irrigation Supply	4,073	4,073	4,073	4,073	4,073	4,073
Surplus (Shortage)	(352)	(352)	(352)	(352)	(352)	(352)
Jim Wells County						
Irrigation Demand	1,913	1,913	1,913	1,913	1,913	1,913
Irrigation Existing Supply						
Groundwater	1,580	1,580	1,580	1,580	1,580	1,580
Surface Water	0	0	0	0	0	0
Total Irrigation Supply	1,580	1,580	1,580	1,580	1,580	1,580
Surplus (Shortage)	(333)	(333)	(333)	(333)	(333)	(333)
Live Oak County						
Irrigation Demand	1,630	1,630	1,630	1,630	1,630	1,630
Irrigation Existing Supply						
Groundwater	1,096	1,096	1,096	1,096	1,096	1,096
Surface Water	191	0	0	0	0	0
Total Irrigation Supply	1,287	1,096	1,096	1,096	1,096	1,096
Surplus (Shortage)	(343)	(534)	(534)	(534)	(534)	(534)
Nueces County						
Irrigation Demand	1,540	1,540	1,540	1,540	1,540	1,540
Irrigation Existing Supply						
Groundwater	1,489	1,489	1,489	1,489	1,489	1,489
Surface Water	0	0	0	0	0	0
Total Irrigation Supply	1,489	1,489	1,489	1,489	1,489	1,489
Surplus (Shortage)	(51)	(51)	(51)	(51)	(51)	(51)
San Patricio County						
Irrigation Demand	14,645	14,645	14,645	14,645	14,645	14,645
Irrigation Existing Supply						
Groundwater	14,441	14,441	14,441	14,441	14,441	14,441
Surface Water	0	0	0	0	0	0
Total Irrigation Supply	14,441	14,441	14,441	14,441	14,441	14,441
Surplus (Shortage)	(204)	(204)	(204)	(204)	(204)	(204)

5D.2.2 Available Yield

All irrigators in the Coastal Bend Region are encouraged to conserve water.

Of the eight counties in Region N with irrigation water demands, five counties show shortages (Table 5D.2.2). The CBRWPG recommends that counties with projected irrigation needs (shortages) reduce their irrigation water demands by 15 percent by 2070. This conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB[4], such as:

1. Irrigation Scheduling;
2. Volumetric Measurement of Irrigation Water Use;
3. Crop Residue Management and Conservation Tillage;
4. On-farm Irrigation audit;
5. Furrow Dikes;
6. Land Leveling;
7. Contour Farming;
8. Conservation of Supplemental Irrigated Farmland to Dry-Land Farmland;
9. Brush Control/Management;
10. Lining of On-Farm Irrigation ditches;
11. Replacement of On-/farm Irrigation Ditches with Pipelines;
12. Low Pressure Center Pivot Sprinkler Irrigation Systems;
13. Drip/Micro-Irrigation System;
14. Gated and Flexible Pipe for Field Water Distribution Systems;
15. Surge Flow Irrigation for Field Water Distribution Systems;
16. Linear Move Sprinkler Irrigation Systems;
17. Lining of District Irrigation Canals;
18. Replacement of District Irrigation canals and Lateral canals with Pipelines;
19. Tailwater Recovery and Use System; and
20. Nursery Production Systems.

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5D.2.3. The TWDB describes how the BMPs reduce irrigation water use, however information regarding specific water savings and costs to install irrigation water saving systems is generally unavailable. Water savings and costs for three irrigation water conservation BMPs are presented: 1) furrow dikes; 2) low-pressure sprinklers (LESA); and 3) low-energy precision application systems (LEPA).

[4] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

These major irrigation water conservation techniques applicable in the Coastal Bend Region are described briefly below.

Table 5D.2.3.
Costs and Savings of Possible Irrigation Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/ Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Irrigation Scheduling	0.3	0.5	0.40	acft/ac/yr	-	-	-	-	Verification of estimated savings attempted by Pacific NW Lab (1994), results inconclusive.
2	Volumetric Measurement of Irrigation Water Use	0	0	0	-	-	-	-	-	Helps inform conservation efforts, but does not directly lead to conservation savings. Cost varies.
3	Crop Residue Management and Conservation Tillage	0.25	1	0.63	acft/ac/yr	-	-	-	-	Cost varies, some conservation tillage programs are less expensive than conventional tillage.
4	On-farm Irrigation audit	-	-	-	-	-	-	-	-	No quantifiable savings or costs. Site and crop use specific.
5	Furrow Dikes	-	-	0.25	acft/ac/yr	$5	$30	$18	per acre/yr	
6	Land Leveling	-	-	0.3	acft/ac/yr	$150	$500	$325	per acre	Savings based on leveled rice fields near the Texas Gulf Coast. Costs reflect initial costs (touch-up costs are much less)
7	Contour Farming	-	-	-	-	$5	$10	$8	per acre	
8	Conservation of Supplemental Irrigated Farmland to Dry-Land	-	-	-	-	-	-	-	-	
9	Brush Control/Management	0.34	0.55	0.45	acft/ac/yr	$36	$203	$119	acre/10 yrs	Cost estimates are per a Texas A&M study; county average costs range from $150 to $200
10	Lining of On-Farm Irrigation ditches	-	-	-	-	$2.50	$3.50	$3	per sq ft	Concrete lining saves about 80% (conservative estimate) of original seepage. Cost is for concrete lining.
11	Replacement of On-/farm Irrigation Ditches with Pipelines	-	-	-	-	-	-	-	-	
12	Low Pressure Center Pivot Sprinkler Irrigation Systems	0.29	0.68	0.49	acft/yr	$300	$500	$400	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
13	Drip/Micro-Irrigation System	-	-	-	-	$800	$1,200	$1,000	per acre	Costs reflect installation costs only (no O&M)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/ Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
14	Gated and Flexible Pipe for Field Water Distribution Systems	-	-	-	-	$20	$25	$23	per acft/yr	*Assuming that 0.25 acft/ac/yr of water is saved
15	Surge Flow Irrigation for Field Water Distribution Systems	0.1	0.4	0.25	acft/yr	$20	$25	$23	per acft/yr	Savings based on a percentage. Cost estimates assume that 0.25 acft/ac/yr of water is saved by using a surge valve
16	Linear Move Sprinkler Irrigation Systems	0.29	0.68	0.49	acft/yr	$300	$700	$500	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
17	Lining of District Irrigation Canals	-	-	-	-	$2.50	$3.50	$3	per sq ft	Cost of concrete lining
18	Replacement of District Irrigation canals and Lateral canals with Pipelines	-	-	-	-	-	-	-	-	
19	Tailwater Recovery and Use System	0.5	1.5	1.00	acft/ac/yr	-	-	-	-	Cost Varies widely
20	Nursery Production Systems	-	-	-	-	-	-	-	-	

5D.2.2.1 Furrow Dikes

Furrow dikes are small mounds of soil mechanically installed a few feet apart in the furrow. These mounds of soil create small reservoirs that capture precipitation and hold it until it soaks into the soil instead of running down the furrow and out the end of the field. This practice can conserve (capture) as much as 100 percent of rainfall runoff, and furrow dikes are used to prevent irrigation runoff under sprinkler systems. This maintains high irrigation uniformity and increases irrigation application efficiencies. Capturing and holding precipitation that would have drained from the fields replaces required irrigation water on irrigated fields; and furrow dikes have been demonstrated to be useful management tools on both irrigated and non-irrigated cropland.

Use of furrow dikes can result in water savings of up to 12 percent gross quantity of water applied using sprinkler irrigation. Furrow dikes require special equipment and costs $5 to $30 per acre to install.

5D.2.2.2 Low Elevation Spray Application (LESA) and Low Energy Precision Application (LEPA)

Low Elevation Spray Application (LESA) with 75 to 90 percent application efficiency improve irrigation application efficiency in comparison to conventional furrow irrigation by reducing water requirements per acre by 15 percent. Low Energy Precision Application (LEPA) systems involve a sprinkler system that has been modified to discharge water directly into furrows at low pressure, thus reducing evaporation losses. When used in conjunction with furrow dikes, which hold both precipitation and sprinkler applied water behind small mounds of earth within the furrows, LEPA systems can accomplish the irrigation objective with less water than is required for the furrow irrigation and pressurized sprinkler methods.

If LEPA is used with furrow dike systems an expected efficiency of 80 to 95 percent is expected. Use of LEPA and furrow dikes allows irrigation farmers to produce equivalent yields per acre at lower energy and labor costs of irrigation. It has been demonstrated that LEPA systems improve production and profitability of irrigation farming. The barriers to installation are high capital costs; with no assurance (at the present time) that the water saved would be available to the irrigation farmer who incurred the costs.

To determine the potential water savings (ac-ft/acre) and cost per acft saved, a five year average of the irrigated acres and water use from 2013-2017 was calculated for each county based on information provided by the USDA National Agricultural Statistics Service (see Table 5D.2.1 for 2017). Based on information shown in Table 5D.2.3 for low pressure center pivot sprinkler irrigation systems and linear move sprinkler irrigation systems, an average cost of $450 per acre to implement LESA/LEPA technologies was assumed. As a conservative estimate, the amount of water saved (ac-ft/acre) assumed 80 percent application efficiency achieved by LESA or LEPA as compared to traditional non-BMP system with 60% efficiency. As shown in Table 5D.2.4, this conversion to higher efficiency BMP is expected to save between 0.09 to 0.31 ac-ft/acre at a cost of $1,434 to $4,822 per ac-ft of water saved.

Table 5D.2.4.
Costs and Savings by Implementing LESA/LEPA Water Conservation Techniques (BMPs)

Region N County	2017 Irrigated Acres[1]	Avg 2013-2017 Irrigated Acres	2017 Water Use (acft)	Avg 2013-2017 Water Use (acft)	Cost per Acre	Water Saved (acft/acre)[2]	$ per acft
Aransas	0	0	0	0	$450	N/A	N/A
Bee	7,240	7,016	2,871	2,619	$450	0.09	$4,822
Brooks	670	696	669	578	$450	0.21	$2,168
Duval	1,670	1,574	2,375	1,976	$450	0.31	$1,434
Jim Wells	1,740	1,668	1,769	1,571	$450	0.24	$1,911
Kenedy	0	0	0	0	$450	N/A	N/A
Kleberg	330	330	83	149	$450	0.11	$3,992
Live Oak	1,540	1,600	696	1,041	$450	0.16	$2,768
McMullen	0	0	0	0	$450	N/A	N/A
Nueces	830	744	440	674	$450	0.23	$1,986
San Patricio	12,190	12,758	5,876	6,443	$450	0.13	$3,564

[1]Includes golf courses.

[2]TWDB BMPs for Ag Water Users. Low Pressure Center Pivot Sprinkler Irrigation Systems ($300-500 per acre) and Linear Move Sprinkler Irrigation Systems ($300-700 per acre). Avg is $400 and $500. Use $450 per acre.

Assumes application of non-BMP system is 60% efficient. LESA/LEPA system gains 80% efficiency, as a conservative estimate.

A 15 percent reduction in irrigation water demand by 2070 for irrigation counties with needs results in a water savings of up to 2,197 ac-ft/yr in 2070 for the region. New needs after conservation are re-calculated for Bee, Jim Wells, Live Oak, Nueces, and San Patricio counties and shown in Table 5D.2.5. If irrigation water conservation savings are attained as recommended, shortages would be reduced for all irrigation counties with needs. For Bee County, the irrigation shortage would be eliminated by 2050. For San Patricio County, the irrigation shortage would be eliminated and surplus could exist for all decades.

Table 5D.2.5. Projected Water Demands and Needs (Shortages) for Irrigation Users after Recommended Irrigation Water Conservation in Bee, Jim Wells, Live Oak, Nueces, and San Patricio Counties

	Projections (ac-ft/yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Bee County						
New Demand	4,320	4,215	4,110	4,005	3,899	3,794
Expected Savings	105	210	315	421	526	631
Shortage After Conservation (ac-ft/yr)	(247)	(142)	(37)	69	174	279
Shortage Reduction (ac-ft/yr)	30%	60%	90%	100%	100%	100%
Jim Wells County						
New Demand	1,865	1,817	1,770	1,722	1,674	1,626
Expected Savings	48	96	143	191	239	287
Shortage After Conservation (ac-ft/yr)	(285)	(237)	(190)	(142)	(94)	(46)
Shortage Reduction (ac-ft/yr)	14%	29%	43%	57%	72%	86%
Live Oak County						
New Demand	1,589	1,549	1,508	1,467	1,426	1,386
Expected Savings	41	82	122	163	204	245
Shortage After Conservation (ac-ft/yr)	(302)	(453)	(412)	(371)	(330)	(290)
Shortage Reduction (ac-ft/yr)	12%	15%	23%	31%	38%	46%
Nueces County						
New Demand	1,539	1,537	1,536	1,535	1,534	1,532
Expected Savings	1	3	4	5	6	8
Shortage After Conservation (ac-ft/yr)	(50)	(48)	(47)	(46)	(45)	(43)
Shortage Reduction (ac-ft/yr)	3%	5%	7%	10%	13%	15%
San Patricio County						
New Demand	14,279	14,645	14,645	14,645	14,645	14,645
Expected Savings	366	732	1,098	1,465	1,831	2,197
Surplus After Conservation (ac-ft/yr)	162	528	894	1,261	1,627	1,993
Shortage Reduction (ac-ft/yr)	100%	100%	100%	100%	100%	100%

5D.2.3 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research, and have been adopted and applied within the Region. Hundreds of LEPA systems have been installed, and are in operation today, and experience has shown that there are not any significant environmental issues associated with this water management strategy. For example, this method improves water use efficiency without making changes to wildlife habitat. This method of application, when coupled with furrow dikes reduces runoff of both applied irrigation water and rainfall, which may have a localized impact on streamflow for irrigated lands adjacent to streams. The results are reduced transport of sediment and any fertilizers or other chemicals that have been applied to the crops. Thus, the proposed conservation practices do not have potential adverse effects, and in fact have potentially beneficial environmental effects.

5D.2.4 Engineering and Costing

The CBRWPG recommended voluntary irrigation water conservation (15 percent reduction in demands by 2070) as a water management strategy for irrigation needs, resulting in a maximum water savings of 3,367 ac-ft/yr in 2070 for Bee, Jim Wells, Live Oak, Nueces, and San Patricio Counties. Region N recommends that irrigators in these counties consider use of LESA or LEPA programs to achieve the recommended water savings targets. Irrigators are to decide which of these or other options would serve them best. Installing LESA or LEPA systems would incur a greater capital cost, and therefore higher annual costs, however both achieve a substantially higher water savings potential and therefore have more economical unit cost ($/ac-ft) when compared to furrow dikes.

An average cost of $450 per acre was estimated as discuss previously in Section 5D.2.2 with the exact technology to implement left to the WUG's discretion to choose the program that works best for them. By implementing BMPs that increase irrigation efficiency from 60% to 80%, the cost per ac-ft of water saved is expected to range from $1,434 to $4,822 per ac-ft (Table 5D.2.4). The estimated costs for Bee, Jim Wells, Live Oak, Nueces, and San Patricio Counties are shown in Table 5D.2.6. Both LESA and LEPA irrigation water conservation strategies have the potential to increase water savings beyond the recommendations of the CBRWPG and could potentially eliminate all irrigation shortages.

It may not be economically feasible for some agricultural producers to pay for additional water supplies to meet projected irrigation water needs (shortages), even if such supplies were available. For example, in 2004, for irrigated cotton, the estimated income remaining after other production expenses had been paid was about $158 per acre. For cotton farming, which is most prevalent in San Patricio County, it may be practical to install furrow, LESA, or LEPA systems. For other crops, if the cost of water exceeds the estimated income, then it would not be practical to pay for additional water.

Table 5D.2.6.
Potential Water Savings and Costs (Total Project, Annual Average, and Unit Costs) to Implement Irrigation Water Conservation BMPs in Bee, Jim Wells, Live Oak, Nueces, and San Patricio Counties[1]

	Projections (ac-ft/yr)					
	2020	2030	2040	2050	2060	2070
Bee County						
Expected Savings (ac-ft)	105	210	315	421	526	631
Costs ($)	$506,951	$1,013,901	$1,520,852	$2,027,803	$2,534,754	$3,041,704
Jim Wells County						
Expected Savings (ac-ft)	48	96	143	191	239	287
Costs ($)	$91,412	$182,824	$274,236	$365,648	$457,059	$548,471
Live Oak County						
Expected Savings (ac-ft)	41	82	122	163	204	245
Costs ($)	$112,781	$225,562	$338,343	$451,124	$563,905	$676,687
Nueces County						
Expected Savings (ac-ft)	1	3	4	5	6	8
Costs ($)	$2,533	$5,065	$7,598	$10,130	$12,663	$15,196
San Patricio County						
Expected Savings (ac-ft)	366	732	1,098	1,465	1,831	2,197
Costs ($)	$1,304,876	$2,609,753	$3,914,629	$5,219,506	$6,524,382	$7,829,259
Total of all 5 Region N counties with Irrigation Needs						
Expected Savings (ac-ft)	561	1,122	1,683	2,244	2,806	3,367
Costs ($)	$2,018,553	$4,037,106	$6,055,658	$8,074,211	$10,092,764	$12,111,317

1 The cost of implementing irrigation water conservation practices was calculated based on estimated water savings and application efficiencies from TWDB Report 347, Surveys of Irrigation in Texas (2001) and costs to implement furrow dikes, LESA, and LEPA programs by acre from TWDB Report 362- Water Conservation Best Management Practices Guide (2013).

5D.2.5 Implementation Issues

The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing. There is widespread public support for irrigation water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of additional irrigation conservation.

5D.2.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.2.7.

Table 5D.2.7. Evaluation Summary of Irrigation Water Conservation

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm yield: Variable according to BMP selected and extent of participation. Conservation savings with 15% target reduction for those with needs is 3,367 ac-ft for the region.
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Cost: $1,434 to $4,822 per ac-ft of water saved.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife habitat	3. No apparent negative impact.
4. Wetlands	4. None.
5. Threatened and endangered species	5. None.
6. Cultural resources	6. None or low. No apparent cultural resources affected.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. None or low impact.
c. Impacts to agricultural resources and State water resources	• None or low. No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing rate of decline of local groundwater levels
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

5D.3

Manufacturing Water Conservation (N-3)

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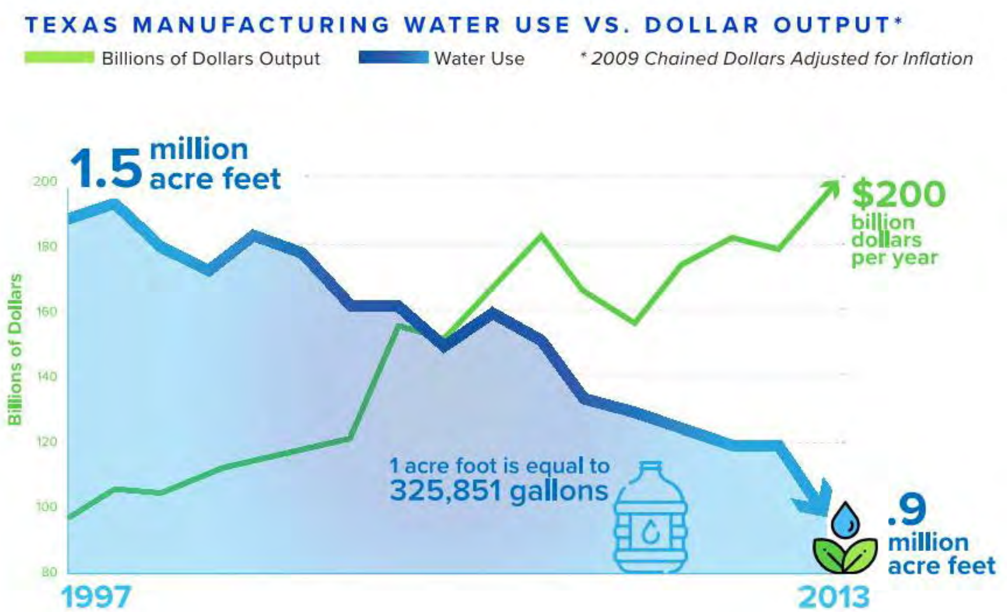
5D.3 Manufacturing Water Conservation (N-3)

5D.3.1 Description of Strategy

Manufacturing is an integral part of the Texas economy, and for many industries, water plays a key role in the manufacturing process. Some of these processes require direct consumption of water as part of the products; others consume very little water but use a large quantity for cleaning and cooling. Over the past two decades, Texas industrial water use has declined by 60 percent at the same time that output product nearly doubled[1], as seen in Figure 5D.3.1. By 2013, Texas produced at least three times what could be produced in 1997 with the same amount of supply.



Source: TWDB, 2017.

Figure 5D.3.1.
Texas Manufacturing Water Demand Trends

Manufacturing water use for the Coastal Bend Region is projected to increase from 44,824 ac-ft in 2010 to 98,480 ac-ft in 2030. Although the manufacturing industry is projected to grow after 2030, long term planning assumes continued efficiency and water demand remains constant from 2030 to 2070 (Figure 5D.3.2). The majority of Region N manufacturing demand occurs in Nueces and San Patricio Counties. Between 2030 and 2070, these two counties account for 95 percent of the total projected manufacturing water use in the region (Figure 5D.3.3). Seven

[1] Presentation "Regional Water Planning Group Technical Webinar", Texas Water Development Board, February 10, 2017.

of the eleven counties in Region N show manufacturing demands. There are no manufacturing demands projected in Aransas, Bee, Duval, or Kenedy Counties.

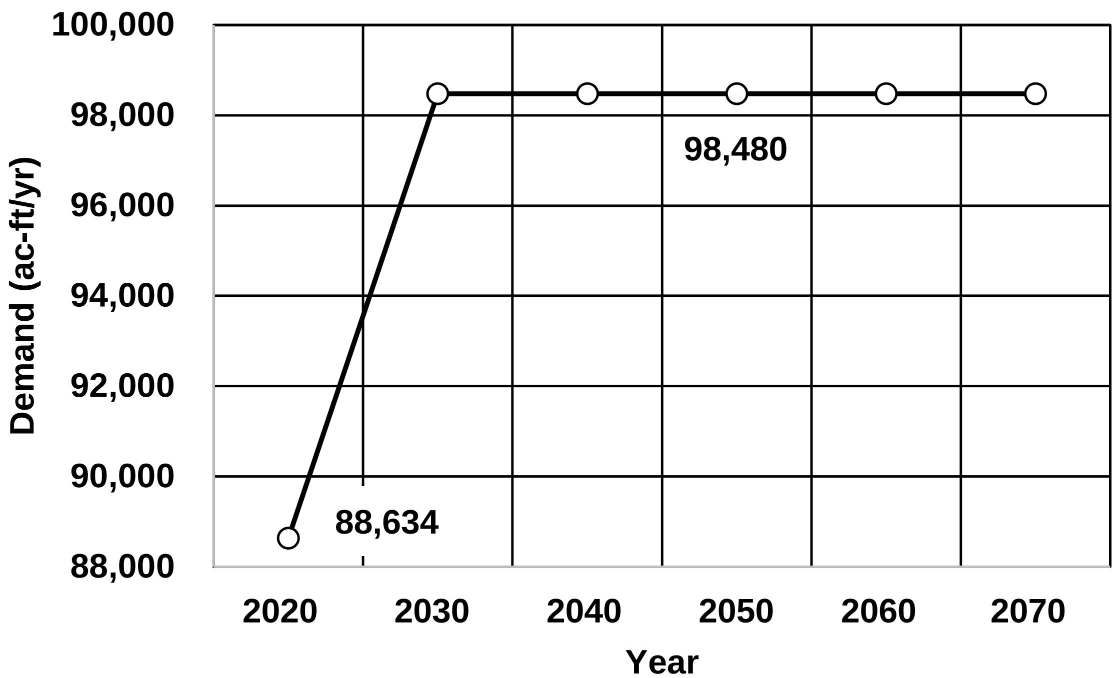


Figure 5D.3.2.
Coastal Bend Region Manufacturing Water Demand Projections

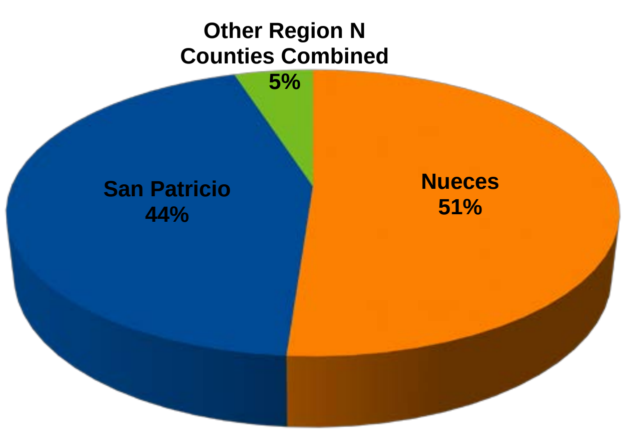


Figure 5D.3.3.
2030-2070 Percentages of Manufacturing Water Demand by County
Total Demand for Coastal Bend Region – 98,480 ac-ft

On June 2, 2017 the TWDB provided draft manufacturing water demand projections for Region N Water Planning Group review and comment. A Region N subcommittee comprised of six Region N members was formed at the August 10, 2017 RWPG meeting to review TWDB draft manufacturing water demand projections. The subcommittee met on September 7, 2017 to discuss TWDB draft projections and local data pertinent to demand projections. At the subcommittee's request, based on local feedback and data, alternative higher demand projections were prepared for Nueces and San Patricio County- manufacturing users representative of local growth and future industries that have been identified in the region. These alternate projections were considered and adopted by Region N at its November 9, 2017 meeting. The TWDB subsequently approved Region N's alternate manufacturing water demand projections in April 2018. The manufacturing water demand projections used in this plan for the Coastal Bend Region were provided by the TWDB, with increases in manufacturing water demands in Nueces and San Patricio Counties approved by Region N.

In the Coastal Bend Region, manufacturing supply is obtained from both surface and groundwater sources. Four of the seven counties with manufacturing demands receive their full supply from groundwater sources. Nueces and San Patricio manufacturing receives nearly all of their water supplies from surface water. Live Oak manufacturing receives most of its water through contract with the City of Three Rivers.

Five of the eleven counties in the Coastal Bend Region have projected manufacturing needs beginning in 2030: Jim Wells, Kleberg, Live Oak, Nueces, and San Patricio Counties, as shown in Table 5D.3.1. Modest shortages remain constant in Jim Wells, Kleberg, and Live Oak Counties, while shortages increase steadily through 2070 in Nueces and San Patricio Counties. The greatest manufacturing shortage (34,150 ac-ft/yr) occurs in 2070 for Nueces County.

TWDB rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The TWDB has provided information on industrial water conservation BMPs, for consideration in the development of the water conservation WMS including a Best Management Practice Guides for Industrial Water Users.

Table 5D.3.1. Projected Water Demands, Supplies, and Water Needs (Shortages) for Manufacturing Users in Jim Wells, Kleberg, Live Oak, Nueces, and San Patricio Counties

	Manufacturing Projections (ac-ft/yr)					
	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)
Jim Wells County						
Manufacturing Demand	79	95	95	95	95	95
Manufacturing Existing Supply						
Groundwater	79	79	79	79	79	79
Surface water	0	0	0	0	0	0
Total Manufacturing Supply	79	79	79	79	79	79
Surplus (Shortage)	0	(16)	(16)	(16)	(16)	(16)
Kleberg County						
Manufacturing Demand	1,809	2,056	2,056	2,056	2,056	2,056
Manufacturing Existing Supply						
Groundwater	1,809	1,809	1,809	1,809	1,809	1,809
Surface water	0	0	0	0	0	0
Total Manufacturing Supply	1,809	1,809	1,809	1,809	1,809	1,809
Surplus (Shortage)	0	(247)	(247)	(247)	(247)	(247)
Live Oak County						
Manufacturing Demand	2,274	2,493	2,493	2,493	2,493	2,493
Manufacturing Existing Supply						
Groundwater	965	965	965	965	965	965
Surface water	1,309	1,500	1,500	1,500	1,500	1,500
Total Manufacturing Supply	2,274	2,465	2,465	2,465	2,465	2,465
Surplus (Shortage)	0	(28)	(28)	(28)	(28)	(28)
Nueces County						
Manufacturing Demand	45,411	50,363	50,363	50,363	50,363	50,363
Manufacturing Existing Supply						
Groundwater	776	802	802	802	802	802
Surface water	44,635	33,418	28,343	24,112	19,628	15,411
Total Manufacturing Supply	45,411	34,220	29,145	24,914	20,430	16,213
Surplus (Shortage)	0	(16,143)	(21,218)	(25,449)	(29,933)	(34,150)
San Patricio County						
Manufacturing Demand	38,841	43,223	43,223	43,223	43,223	43,223
Manufacturing Existing Supply						
Groundwater	25	25	25	25	25	25
Surface water	39,006	36,139	33,665	31,087	28,493	25,635
Total Manufacturing Supply	39,031	36,164	33,690	31,112	28,518	25,660
Surplus (Shortage)	190	(7,059)	(9,533)	(12,111)	(14,705)	(17,563)

5D.3.2 Available Yield

All manufacturing entities in the Coastal Bend Region are encouraged to conserve water.

Of the seven counties in Region N with manufacturing water demands, five counties show shortages (Table 5D.3.1). The CBRWPG recommends that counties with projected manufacturing needs (shortages) reduce their manufacturing water demands by 15 percent by 2070.

The TWDB lists the following industrial BMPs that may be used to achieve water savings[2]:

1. Industrial Water Audit
2. Industrial Water Waste Reduction
3. Industrial Submetering
4. Cooling Towers
5. Cooling Systems (other than Cooling Towers)
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water
7. Rinsing/Cleaning
8. Water Treatment
9. Boiler and Steam Systems
10. Refrigeration (including Chilled Water)
11. Once-Through Cooling
12. Management and Employee Programs
13. Industrial Facility Landscaping
14. Industrial Site Specific Conservation

A 15 percent reduction in manufacturing water demand by 2070 results in a total savings of 14,735 ac-ft/yr for the region, as shown in Table 5D.3.2. If manufacturing water conservation savings are attained as recommended, shortages would be reduced for all manufacturing counties with needs. New needs after conservation are re-calculated as shown in Table 5D.3.2. For Kleberg County, the manufacturing shortage would be eliminated by 2060. For Live Oak County, the manufacturing shortage would be eliminated and surplus could exist for all decades. The CBRWPG-recommended water conservation goal alone is insufficient to fully address manufacturing shortages in Region N and additional strategies are considered to address this projected supply deficit (See Chapter 5B).

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5D.3.3. The TWDB describes how the BMPs reduce water use, however information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are facility and process specific. Since manufacturing entities are presented on a county basis and are not individually identified, identification and quantifying savings of specific water management strategies are not a reasonable expectation.

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[2] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

Table 5D.3.2. Projected Water Demands and Needs (Shortages) for Manufacturing Users Considering a 15 Percent Demand Reduction in Jim Wells, Kleberg, Live Oak, Nueces, and San Patricio Counties

	Projections (ac-ft/yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Jim Wells County						
New Demand (after conservation)	77	90	88	86	83	81
Expected Savings	2	5	7	10	12	14
Balance After Conservation (ac-ft/yr)	2	(11)	(9)	(7)	(4)	(2)
Shortage Reduction (ac-ft/yr)	N/A	30%	45%	59%	74%	89%
Kleberg County						
New Demand (after conservation)	1,764	1,953	1,902	1,850	1,799	1,748
Expected Savings	45	103	154	206	257	308
Balance After Conservation (ac-ft/yr)	45	(144)	(93)	(41)	10	61
Shortage Reduction (ac-ft/yr)	N/A	42%	62%	83%	100%	100%
Live Oak County						
New Demand (after conservation)	2,217	2,368	2,306	2,244	2,181	2,119
Expected Savings	57	125	187	249	312	374
Balance After Conservation (ac-ft/yr)	57	97	159	221	284	346
Shortage Reduction (ac-ft/yr)	N/A	100%	100%	100%	100%	100%
Nueces County						
New Demand (after conservation)	44,276	47,845	46,586	45,327	44,068	42,809
Expected Savings	1,135	2,518	3,777	5,036	6,295	7,554
Balance After Conservation (ac-ft/yr)	1,135	(13,625)	(17,441)	(20,413)	(23,638)	(26,595)
Shortage Reduction (ac-ft/yr)	N/A	16%	18%	20%	21%	22%
San Patricio County						
New Demand (after conservation)	37,870	41,062	39,981	38,901	37,820	36,740
Expected Savings	971	2,161	3,242	4,322	5,403	6,483
Balance After Conservation (ac-ft/yr)	1,161	(4,898)	(6,291)	(7,788)	(9,303)	(11,079)
Shortage Reduction (ac-ft/yr)	N/A	31%	34%	36%	37%	37%
Total Manufacturing Savings (Region N)	**2,210**	**4,912**	**7,367**	**9,823**	**12,279**	**14,735**

Table 5D.3.3.
Costs and Savings of Possible Manufacturing Water Conservation Techniques (BMPs)

	Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Industrial Water Audit	10	35	22.5	%	-	-	-	-	
2	Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	
3	Industrial Submetering	-	-	-	-	-	-	-	-	
4	Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
5	Cooling Systems (other than Cooling Towers)	-	90	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
6	Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	
7	Rinsing/Cleaning	-	-	-	-	-	-	-	-	
8	Water Treatment	10	85	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
9	Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
10	Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	
11	Once-Through Cooling	-	-	-	-	-	-	-	-	
12	Management and Employee Programs	-	-	-	-	-	-	-	-	
13	Industrial Facility Landscaping	-	-	15	%	-	-	-	-	
14	Industrial Site Specific Conservation	10	95	52.5	%	-	-	-	-	Savings vary widely based on specific measure - from water audits to changing from potable to recycled water.

Source: TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp.

5D.3.3 Environmental Issues

The TWDB BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making changes to wildlife habitat. Thus, the proposed conservation practices do not have anticipated potential adverse effects, and in fact have potentially beneficial environmental effects.

5D.3.4 Engineering and Costing

The CBRWPG recommends implementing voluntary water conservation for manufacturing users with shortages to reduce their water demand by 15 percent by 2070. The Coastal Bend Region can save up to 14,735 ac-ft/yr in 2070 with this approach. Costs to implement BMPs vary from site to site and the Region recognizes that manufacturing industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing manufacturing water conservation strategies.

5D.3.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Coastal Bend Region. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for manufacturing water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand and the Coastal Bend industrial sector grows at a strong rate into the future, conservation practices will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of manufacturing conservation.

5D.3.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.3.4.

Table 5D.3.4. Evaluation Summary of Manufacturing Water Conservation

Impact Category	Comment(s)
a. Water Supply 1 Quantity 2. Reliability 3. Cost of Treated Water	 1. Firm Yield: Variable, Max of 14,735 ac-ft/yr (2070) 2. Reliable quantity with proven BMPs 3. Cost: Highly variable based on BMP selected and facility specifics.
b. Environmental factors 1. Instream flows 2. Bay and Estuary Inflows and arms of the Gulf of Mexico 3. Wildlife Habitat 4. Wetlands 5. Threatened and Endangered Species 6. Cultural Resources 7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	 1. None or low impact. 2. None or low impact. 3. None or low impact. 4. None or low impact. 5. None. 6. No cultural resources affected. 7. None or low impact.
c. Impacts to agricultural resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

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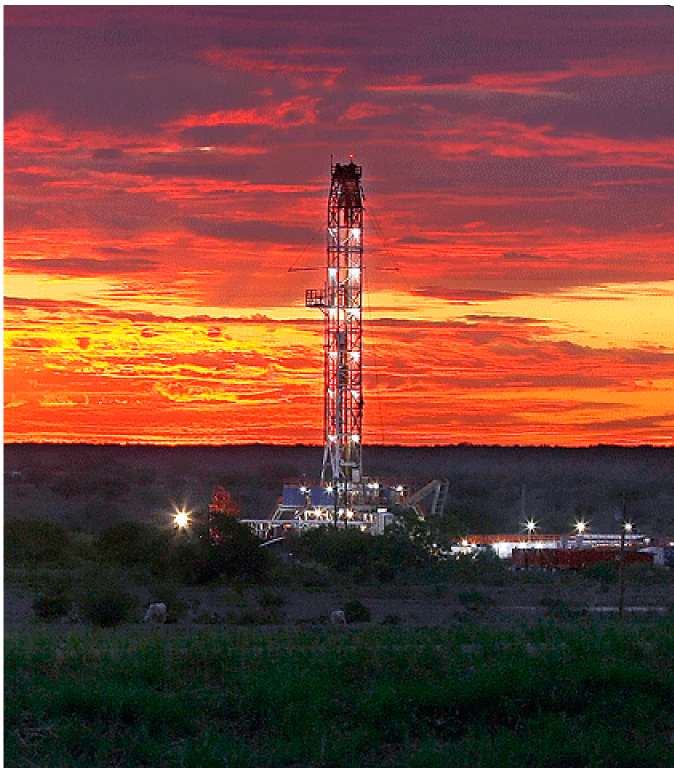

5D.4

Mining Water Conservation (N-4)

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5D.4 Mining Water Conservation (N-4)

5D.4.1 Description of Strategy

Water for mining uses is primarily associated with oil and gas extraction, coal mining, metal mining, and nonmetallic mineral operations. Gross state domestic product data released from the U.S. Department of Commerce showed mining economic outputs of $158,860.9 billion for 2012 and $161,669.6 billion for 2018.[1] Individual county data is not readily available. The TWDB water demand projections for mining users is generally based on projected economic output, assuming that past and current water use trends remain constant over time.

The mining water demand projections used in this plan for the Coastal Bend Region were provided by the TWDB and remained the same as those used in the 2016 Region N Plan. In the Coastal Bend Region, the trends for mining water demands are projected to increase from 2020 to 2030 with a maximum demand of 9,821 ac-ft and then decrease after 2030 to a minimum of 5,497 ac-ft/yr in 2070 as shown in Figure 5D.4.1. The decrease in water demand is due to anticipated slowdown of Eagleford Shale mining activities in the Coastal Bend Region. McMullen County has the largest projected mining water demands, constituting about half of the regional mining water demand in 2030 (Figure 5D.4.2).

In the Coastal Bend Region, all counties receive their full mining supply from groundwater sources. Existing groundwater supplies were based on TCEQ reported well capacity, when available. In most cases, however, mining well capacity information was not publicly available. For this reason, mining groundwater supplies were calculated based on highest use from recent TWDB historical water use records (2012-2015) subject to MAG (i.e groundwater availability).

Eight of the eleven counties in the Coastal Bend Region have projected mining needs: Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, and San Patricio counties, as shown in Table 5D.4.1. Overall, shortages in the region peak in 2030 and decline to 2070 due to the reduction in mining water demands expected with reductions in Eagleford shale activities assumed after 2030. However, the greatest mining shortage (1,127 ac-ft/yr) occurs in 2070 for Nueces County.

TWDB rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The TWDB has provided information on industrial water conservation BMPs, for consideration in the development of the water conservation WMS including a Best Management Practice Guides for Industrial Water Users.

[1] Bureau of Economic Analysis, U.S. Department of Commerce. https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1#reqid=70&step=1&isuri=1

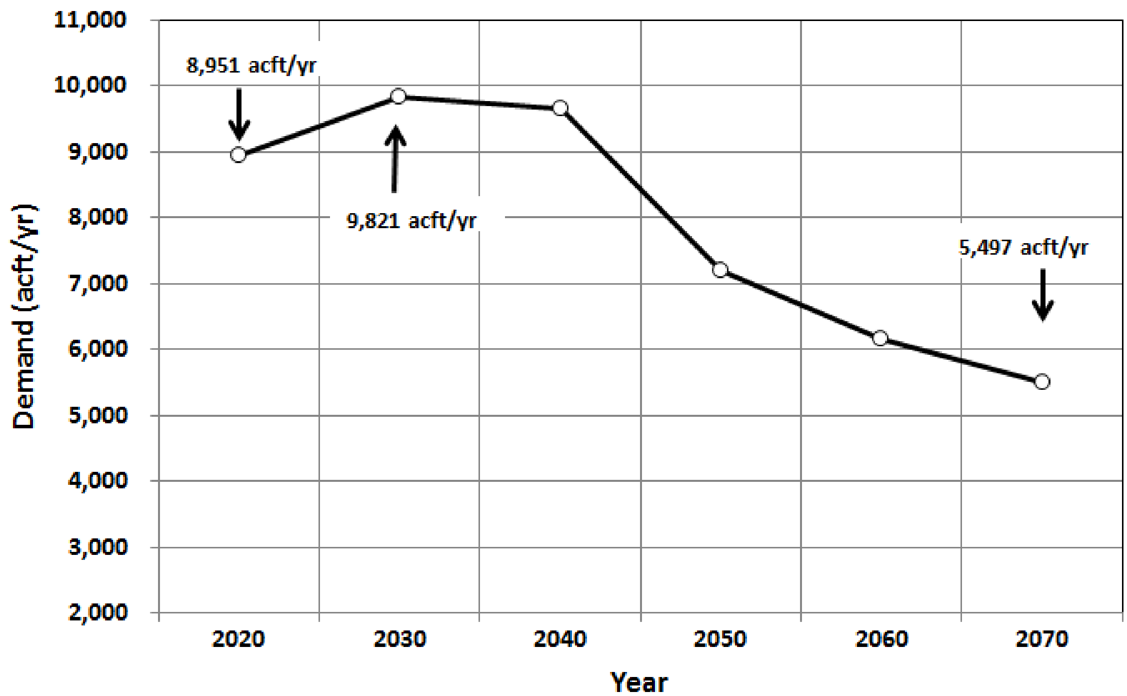

Figure 5D.4.1.
Coastal Bend Region Mining Water Demand Projections

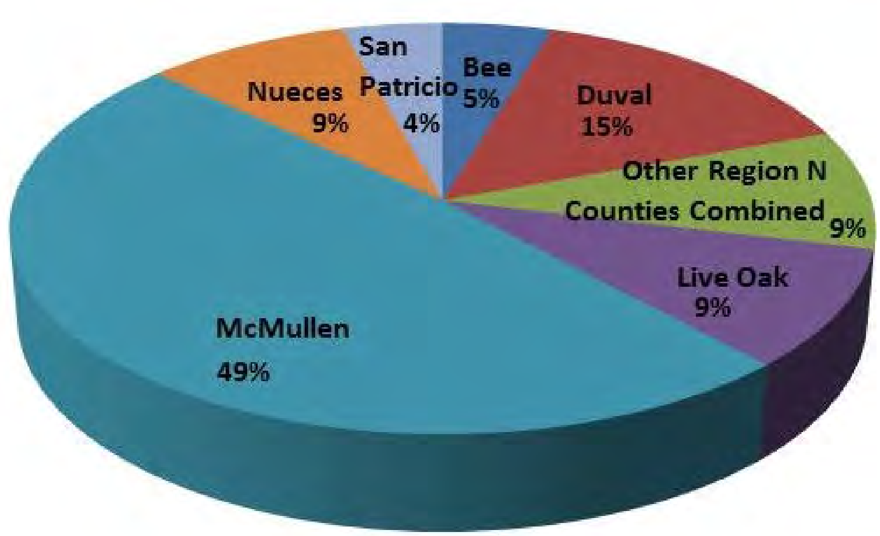

Figure 5D.4.2.
2030 Percentages of Mining Water Demand by County
Total Demand for Coastal Bend Region – 9,821 ac-ft

Table 5D.4.1.
Projected Water Demands, Supplies, and Water Needs (Shortages) for Mining Users in Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, and San Patricio Counties

	Mining Projections (ac-ft/yr)					
	2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Bee County						
Mining Demand	472	458	428	372	338	318
Mining Existing Supply						
Groundwater	275	273	270	263	259	256
Surface Water	0	0	0	0	0	0
Total Mining Supply	275	273	270	263	259	256
Surplus (Shortage)	(197)	(185)	(158)	(109)	(79)	(62)
Brooks County						
Mining Demand	357	360	340	324	308	298
Mining Existing Supply						
Groundwater	178	178	178	178	178	178
Surface Water	0	0	0	0	0	0
Total Mining Supply	178	178	178	178	178	178
Surplus (Shortage)	(179)	(182)	(162)	(146)	(130)	(120)
Duval County						
Mining Demand	1,388	1,444	1,352	1,241	1,165	1,104
Mining Existing Supply						
Groundwater	676	676	676	676	676	676
Surface Water	0	0	0	0	0	0
Total Mining Supply	676	676	676	676	676	676
Surplus (Shortage)	(712)	(768)	(676)	(565)	(489)	(428)
Jim Wells County						
Mining Demand	71	74	55	40	26	17
Mining Existing Supply						
Groundwater	19	19	19	19	19	16
Surface Water	0	0	0	0	0	0
Total Mining Supply	19	19	19	19	19	16
Surplus (Shortage)	(52)	(55)	(36)	(21)	(7)	(1)
Kenedy County						
Mining Demand	118	123	92	68	43	27
Mining Existing Supply						
Groundwater	60	60	60	60	43	27
Surface Water	0	0	0	0	0	0
Total Mining Supply	60	60	60	60	43	27
Surplus (Shortage)	(58)	(63)	(32)	(8)	0	0

	Mining Projections (ac-ft/yr)					
	2020 (ac-ft)	**2030 (ac-ft)**	**2040 (ac-ft)**	**2050 (ac-ft)**	**2060 (ac-ft)**	**2070 (ac-ft)**
Kleberg County						
Mining Demand	357	360	340	324	308	298
Mining Existing Supply						
Groundwater	218	218	218	218	218	218
Surface Water	0	0	0	0	0	0
Total Mining Supply	218	218	218	218	218	218
Surplus (Shortage)	(139)	(142)	(122)	(106)	(90)	(80)
Nueces County						
Mining Demand	724	853	947	1,021	1,130	1,260
Mining Existing Supply						
Groundwater	95	104	111	116	124	133
Surface Water	0	0	0	0	0	0
Total Mining Supply	95	104	111	116	124	133
Surplus (Shortage)	(629)	(749)	(836)	(905)	(1,006)	(1,127)
San Patricio County						
Mining Demand	372	421	440	460	492	533
Mining Existing Supply						
Groundwater	135	135	135	135	135	135
Surface Water	0	0	0	0	0	0
Total Mining Supply	135	135	135	135	135	135
Surplus (Shortage)	(237)	(286)	(305)	(325)	(357)	(398)

5D.4.2 Available Yield

All mining entities in the Coastal Bend Region are encouraged to conserve water.

Of the eleven counties in Region N with mining water demands, eight counties show shortages (Table 5D.4.1). The CBRWPG recommends that counties with projected mining needs (shortages) reduce their mining water demands by 15 percent by 2070. A 15 percent reduction in mining water demand by 2070 results in a total savings of 374 ac-ft for the region, as shown in Table 5D.4.2. The CBRWPG-recommended water conservation goal alone is insufficient to fully address mining shortages in Region N and additional strategies are considered to address this projected supply deficit (See Chapter 5B).

Table 5D.4.2.
Projected Water Demands and Needs (Shortages) for Mining Users Considering a 15 Percent Demand Reduction in Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, and San Patricio Counties

	Projections (ac-ft/yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Bee County						
New Demand (after conservation)	462	438	400	339	301	276
Expected Savings	10	20	28	33	37	42
New Mining Shortage (after recommended conservation)	(187)	(165)	(130)	(76)	(42)	(20)
Shortage Reduction (ac-ft/yr)	5%	11%	18%	30%	47%	68%
Brooks County						
New Demand (after conservation)	348	342	315	292	270	253
Expected Savings	9	18	26	32	39	45
New Mining Shortage (after recommended conservation)	(170)	(164)	(137)	(114)	(92)	(75)
Shortage Reduction (ac-ft/yr)	5%	10%	16%	22%	30%	37%
Duval County						
New Demand (after conservation)	1,353	1,372	1,251	1,117	1,019	938
Expected Savings	35	72	101	124	146	166
New Mining Shortage (after recommended conservation)	(677)	(696)	(575)	(441)	(343)	(262)
Shortage Reduction (ac-ft/yr)	5%	9%	15%	22%	30%	39%
Jim Wells County						
New Demand (after conservation)	69	70	51	36	23	14
Expected Savings	2	4	4	4	3	3
New Mining Shortage (after recommended conservation)	(50)	(51)	(32)	(17)	(4)	2
Shortage Reduction (ac-ft/yr)	4%	7%	11%	19%	46%	N/A
Kenedy County						
New Demand (after conservation)	115	117	85	61	38	23
Expected Savings	3	6	7	7	5	4
New Mining Shortage (after recommended conservation)	(55)	(57)	(25)	(1)	5	4
Shortage Reduction (ac-ft/yr)	5%	10%	22%	85%	100%	100%
Kleberg County						
New Demand (after conservation)	348	342	315	292	270	253
Expected Savings	9	18	26	32	39	45
New Mining Shortage (after recommended conservation)	(130)	(124)	(97)	(74)	(52)	(35)
Shortage Reduction (ac-ft/yr)	6%	13%	21%	31%	43%	56%
Nueces County						
New Demand (after conservation)	723	851	944	1,017	1,124	1,253
Expected Savings	1	2	3	4	6	8
New Mining Shortage (after recommended conservation)	(628)	(747)	(833)	(901)	(1,000)	(1,120)
Shortage Reduction (ac-ft/yr)	0%	0%	0%	0%	1%	1%

	Projections (ac-ft/yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
San Patricio County						
New Demand (after conservation)	365	404	414	424	443	470
Expected Savings	7	17	26	36	49	63
New Mining Shortage (after recommended conservation)	(230)	(269)	(279)	(289)	(308)	(335)
Shortage Reduction (ac-ft/yr)	3%	6%	9%	11%	14%	16%
Total Mining Savings (Region N)	76	157	221	273	323	374

The TWDB lists the following industrial BMPs that may be used to achieve the recommended water savings[2]:

1. Industrial Water Audit
2. Industrial Water Waste Reduction
3. Industrial Submetering
4. Cooling Towers
5. Cooling Systems (other than Cooling Towers)
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water
7. Rinsing/Cleaning
8. Water Treatment
9. Boiler and Steam Systems
10. Refrigeration (including Chilled Water)
11. Once-Through Cooling
12. Management and Employee Programs
13. Industrial Facility Landscaping
14. Industrial Site Specific Conservation

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5D.4.3. The TWDB describes how the BMPs reduce water use, however information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are facility and process specific. Since mining entities are presented on a county basis and are not individually identified, identification and quantifying savings of specific water management strategies are not a reasonable expectation.

[2] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

Table 5D.4.3.
Costs and Savings of Possible Mining Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Industrial Water Audit	10	35	22.5	%	-	-	-	-	
2	Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	
3	Industrial Sub-metering	-	-	-	-	-	-	-	-	
4	Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
5	Cooling Systems (other than Cooling Towers)	-	90	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
6	Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	
7	Rinsing/Cleaning	-	-	-	-	-	-	-	-	
8	Water Treatment	10	85	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
9	Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
10	Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	
11	Once-Through Cooling	-	-	-	-	-	-	-	-	
12	Management and Employee Programs	-	-	-	-	-	-	-	-	
13	Industrial Facility Landscaping	-	-	15	%	-	-	-	-	
14	Industrial Site Specific Conservation	10	95	52.5	%	-	-	-	-	Savings vary widely - from water audits to changing from potable to recycled water.

5D.4.3 Environmental Issues

The TWDB BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making changes to wildlife habitat. Thus, the proposed conservation practices do not have anticipated potential adverse effects, and in fact have potentially beneficial environmental effects.

5D.4.4 Engineering and Costing

The CBRWPG recommends implementing voluntary water conservation for mining users with shortages to reduce their water demand by 15 percent by 2070. The Coastal Bend Region can save up to 374 ac-ft/yr in 2070 with this approach. Costs to implement BMPs vary from site to site and the Region recognizes that mining industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing mining water conservation strategies.

5D.4.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Coastal Bend Region. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for mining water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

5D.4.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.4.4.

Table 5D.4.4.
Evaluation Summary of Mining Water Conservation

Impact Category	Comment(s)
a. Water Supply	
1 Quantity	1. Firm Yield: Variable, Max of 374 ac-ft/yr (2070)
2. Reliability 3. Cost of Treated Water	2. Reliable quantity with proven BMPs. 3. Cost: Highly variable based on BMP selected and facility specifics.
b. Environmental factors	
1. Instream flows	1. None or low impact.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	
c. Impacts to agricultural resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

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5D.5

Reclaimed Wastewater Supplies and Reuse (N-5)

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5D.5 Reclaimed Wastewater Supplies and Reuse (N-5)

5D.5.1 Background

A part of the quantity of water that is used for municipal and industrial purposes is consumed and a part is used for sanitary waste removal from homes, and for sanitary and process-related water use in commercial and industrial establishments. In the Coastal Bend Area, wastewater is collected, treated to acceptable standards as specified by regulatory agencies — Texas Commission on Environmental Quality (TCEQ) and U.S. Environmental Protection Agency (EPA) — and is either reused for non-potable purposes such as industrial uses or golf course irrigation or discharged to some receiving water. In the Corpus Christi area, significant treated effluent quantities are discharged into streams that flow into the bays and meet a part of the freshwater needs of the Nueces Estuary.

Based on conversations with local stakeholders during development of the 2021 Coastal Bend Regional Water Plan and TWDB rules, two reuse strategies were identified and discussed by Region N subcommittee on June 27, 2018. At the Region N meeting on August 9, 2018, the CBRWPG requested the evaluation of the following two reuse strategies for the 2021 Region N Plan: 1) Regional Industrial Wastewater Reuse Plan for Aransas Pass, Ingleside, Gregory and Portland (considered by San Patricio Municipal Water District) and 2) City of Alice Non-Potable Reuse from the Southside Wastewater Treatment Plant. Previous wastewater reuse strategies considered in the 2016 Region N Plan are summarized in Chapter 11 including (a) wastewater reuse for municipal and industrial non-potable purposes; (b) CCR/LCC yield recovery through diversion of WWTP effluent and/or freshwater river diversion through the City of Corpus Christi Rincon Pipeline to the Nueces Delta to enhance biological productivity of estuarine marshes (in comparison to the present practice of direct discharge of wastewater into the bays and into streams that flow into the bays); and (c) discussions of wastewater reuse and water conservation effects upon estuarine inflows.

Both reuse and diversion to the Nueces Delta present opportunities to increase the Corpus Christi area water supply. In the Interim Order[1] of October 9, 1992, the TCEQ established temporary operational procedures for the City's reservoirs that included a monthly schedule of minimum desired inflows to Nueces Bay. The 1992 Interim Order directed studies of the effects of freshwater releases upon the estuary and the feasibility of relocating wastewater discharges to the upper estuary locations where increased biological productivity could justify an inflow credit computed by multiplying the amount of discharge by a number greater than one. These studies included the Allison Wastewater Treatment Plant (WWTP) Demonstration Project.

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[1] Interim Order Establishing Operational Procedures Pertaining to Special Condition 5.B, Certificate of Adjudication No. 21-3214, held by the City of Corpus Christi, Nueces River Authority, and the City of Three Rivers, Texas Water Commission (now TCEQ), Austin, Texas, October 9, 1992.

On April 28, 1995, the TCEQ replaced the 1992 Interim Order with an Agreed Order[2] (1995 Agreed Order) amending the Choke Canyon Reservoir/Lake Corpus Christi (CCR/LCC) System operational procedures. The 1995 Agreed Order directed the Nueces Estuary Advisory Council (NEAC) to continue studying the development of a methodology using a multiplier system for granting credits for specific return flows that increase biological productivity.

On April 17, 2001, the TCEQ issued an amendment to the 1995 Agreed Order to revise operational procedures in accordance with revisions requested by the City of Corpus Christi. Changes included: 1) reductions in the passage of inflows to Nueces Bay and Estuary at 40 percent and 30 percent reservoir system capacity upon institution of mandatory outdoor watering restrictions; 2) calculating reservoir system storage capacity based on most recently completed bathymetric surveys; and 3) provisions for operating Rincon Bayou diversions and conveyance facility from Calallen Pool to deliver up to the first 3,000 ac-ft of target pass through to the upper Rincon Bayou in the Nueces Delta to enhance the amount of freshwater to Delta. Nueces Delta projects, such as Rincon Bayou and Allison WWTP Demonstration Projects, include the following potential benefits: increased water supply, increase positive flow events for Nueces Delta, and increased sources of nitrogen and lower salinity levels for the upper delta. A study completed in 2006[3] outlined the positive benefits of the Allison WWTP Demonstration Project. This report concluded that there was an increase in vegetation and creation of additional areas of salt marsh which was accompanied by more shorebirds being attracted to the area. The report also noted that with the additional water diverted to the marsh area, there was an approximately 50 percent removal of wastewater discharge into the Nueces River, reducing the potential for nutrient driven algal blooms. To evaluate the potential benefits, the 2001 Agreed Order included implementation of an ongoing monitoring program to facilitate an adaptive management program for freshwater inflows to the Nueces Estuary. NEAC prepared a recommended monitoring plan in July 2002, which was initiated in 2003.[4] The Allison WWTP discharge permit includes limitations on ammonia concentrations in the flows to the demonstration project. As a result, the City has curtailed these flows.

The Rincon Bayou Diversion Pipeline and Pump Station (Rincon pipeline) was constructed by the City of Corpus Christi pursuant to the 2001 Agreed Order and became operational in November 2007. Pursuant to the Agreed Order, the City also reopened the Nueces River Overflow Channel which has become the primary method of delivering flow to the Nueces Delta. The Rincon pipeline pump station includes three 350 horsepower mixed flow submersible pumps capable of delivering up to 60,000 gallons per minute (or 265 ac-ft/day) with all pumps operating. The Rincon pipeline and pump station does not operated continuously, however the City has operated the Rincon pipeline to provide inflow to the Upper Rincon Bayou and participated in studies with the Coastal Bend Bays and Estuaries Program to study the impacts of freshwater pumped

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[2] Agreed Order Establishing Operational Procedures Pertaining to Special Condition 5.B., Certificate of Adjudication No. 21-3214, held by the City of Corpus Christi, Nueces River Authority, and the City of Three Rivers, Texas Natural Resource Conservation Commission, Austin, Texas, April 26, 1995.

[3] Concluding Report: Allison Wastewater Treatment Plant Effluent Diversion Demonstration Project, Volume I: Executive Summary. The University of Austin, Marine Science Institute, Port Aransas, Texas and Texas A&M University-Corpus Christi, Center for Coastal Studies, Corpus Christi, Texas, 2006.

[4] City of Corpus Christi, Final Integrated Monitoring Plan Fiscal Year 2005, January 2005.

through the Rincon pipeline on reducing salinity levels in the Nueces Delta.[5] According to USACE studies, pulsed flow at certain times of the year are more beneficial than small pass-throughs in dry months. More recent studies[6] may indicate that small, continuous flows throughout the year improve ecological stability. Salinity monitors have been positioned throughout the estuary to track flow rate and retention time of water diverted through the Rincon Pipeline. The City continues to support programs to monitor salinity and gages.[7]

These agreements and their history are very important and must be considered in water supply planning, water reuse options, and water management programs for the Corpus Christi area. In the following subsections of this report, estimates of the quantities of municipal and industrial wastewater currently discharged are presented, and wastewater reuse practices and plans by cities and industries, and potential wastewater diversion to the Nueces Delta are described.

5D.5.1.1 Inventory and Location of Existing Wastewater Sources

There are about 64 active, permitted domestic and industrial WWTP discharges that discharge to the Corpus Christi Bay System in the 11-county Coastal Bend Region. These domestic and industrial discharges totaled about 84,663 ac-ft in 2017 and 92,327 ac-ft in 2018 based on annual discharges summarized in the Nueces River Authority's 2018 Effluent Monitoring Report (Table 5D.5.1).

The 2001 Agreed Order assumes return flows of 54,000 ac-ft/yr to the Corpus Christi Bay to alleviate hypersaline conditions in the Nueces Bay and Delta. A credit of 6,000 ac-ft/yr is provided for return flows delivered to the Nueces Delta system. Treated wastewater effluent volume exceeding this amount is potentially eligible for recovery and reuse, prior to releasing as return flow.

Figure 5D.5.1 shows the location of the City of Corpus Christi WWTPs, which are the major municipal discharges into the system. In 2018, of the 92,327 ac-ft, major municipal/domestic discharges generated about 59,285 ac-ft/yr and are italicized in Table 5D.5.1 (64 percent), while industrial discharges generated about 33,042 ac-ft/yr (36 percent).

[5] Coastal Bend Bays and Estuaries Program, "Nueces Delta Salinity Effects from Pumping Freshwater into the Rincon Bayou: 2009 to 2013," August 2013.
[6] Montagna, P.A., L. Adams, C. Chaloupka, E. Del Rosario, R.D. Kalke, and E.L Turner. 2016. Determining Optimal Pumped Flows to Nueces Delta. Final Report to the Texas Water Development Board, Contract # 1548311787. Harte Research Institute, Texas A&M University- Corpus Christi, Corpus Christi, Texas, 75 p.
[7] City of Corpus Christi staff, April 3, 2015.

Table 5D.5.1. Summary of Annual Permitted Wastewater Discharges for 2017 and 2018 into the Corpus Christi Bay and Nueces Bay System[1,2]

Facility	2017 Discharge (ac-ft/yr)	2018 Discharge (ac-ft/yr)	Discharge Limit (ac-ft/yr)
Town of Woodsboro	*134.36*	*116.74*	*280.04*
City of Sinton	*533.79*	*528.14*	*896.12*
Texas Department of Transportation	0.09	0.08	0.43
Rob & Bessie Welder Park	*2.62*	*4.72*	*16.80*
St. Paul WSC	*5.45*	*33.58*	*56.01*
City of Beeville-Chase Field	*503.44*	*466.60*	*2,800.36*
City of Beeville-Moore St.	*2,434.52*	*2,460.67*	*3,360.43*
Flint Hills Resources	3,102.37	2,181.58	-
City of Corpus Christi - Allison	*3,162.80*	*3,266.68*	*5,600.72*
San Patricio County MUD #1	*15.23*	*32.03*	*84.01*
City of Agua Dulce	*29.37*	*38.79*	*179.22*
City of Orange Grove	*115.37*	*112.32*	*224.03*
City of Driscoll	*41.47*	*47.41*	*112.01*
Nueces County WCID #5	*56.49*	*62.57*	*112.01*
Bishop CISD	*2.48*	*2.94*	*8.96*
Coastal Bend Detention Facility	*111.93*	*147.82*	*168.02*
International Education Services - Driscoll	*4.08*	*2.22*	*10.08*
City of Rockport	*959.17*	*1,209.32*	*2,800.36*
Holiday Beach WSC	*14.23*	*21.79*	*134.42*
City of Taft	*390.34*	*433.63*	*1,008.13*
Town of Bayside	*3.25*	*2.79*	*71.91*
E.I. Du Pont De Nemours and Co.	5,794.85	8,498.45	-
U.S. Department of the Navy - Corpus Christi NAS	371.26	475.20	1,680.22
Occidental Chemical Corp.	1,978.60	2,282.67	3,125.20
Voestalpine	2,040.13	1,316.40	6,743.27
City of Gregory	*155.28*	*202.90*	*358.45*
City of Ingleside	*846.92*	*984.60*	*1,344.17*
Nueces County WCID #4 Mustang Island North Plant	*1,062.93*	*1,084.18*	*2,105.87*
City of Odem	*170.21*	*204.07*	*532.07*
City of Portland	*1,622.41*	*1,808.11*	*2,800.36*
Sublight Enterprises, Inc.	1.73	1.78	10.08
City of Aransas Pass	*726.21*	*432.80*	*1,792.23*
Gulf Marine Fabricators	1.25	-	13.44
Martin Operating Partnership LP	*0.15*	*0.17*	*4.26*
American Chrome and Chemicals	*4,735.41*	*6,581.93*	*22,402.88*
Flint Hills Resources	*1,242.12*	*1,403.91*	*2,419.51*
Valero Refining, East Plant	*1,592.91*	*1,752.73*	*3,360.43*
Citgo Refining and Chemicals	6,410.63	6,244.15	-
Flint Hills	4,865.43	5,624.75	-
Valero Refining, Texas LP	3,379.06	1,986.09	6,429.62
Equistar Chemicals, LP	1,473.99	1,258.22	-

Facility	2017 Discharge (ac-ft/yr)	2018 Discharge (ac-ft/yr)	Discharge Limit (ac-ft/yr)
BTB Refining (Trigeant Ltd.)	19.46	21.42	134.42
John Bludworth Shipward	*591.23*	*106.73*	-
M&G Resins	98.36	-	43,125.54
Buckeye Texas Processing	59.08	63.99	221.34
Koch Sulfur Products Company	-	243.32	-
City of Corpus Christi - Broadway	*4,342.02*	*5,237.55*	*11,201.44*
City of Corpus Christi - Oso	*12,424.18*	*13,694.42*	*26,883.45*
Equistar Chemicals, LP	-	681.14	-
City of Robstown	*1,232.16*	*1,221.42*	*3,360.43*
City of Corpus Christi - Greenwood	*5,709.05*	*6,026.01*	*17,922.30*
Corpus Christi Peoples Baptist Church	*3.66*	*3.56*	*22.40*
City of Corpus Christi - Laguna Madre	*1,645.69*	*2,243.94*	*3,360.43*
City of Corpus Christi - Whitecap	*1,784.59*	*2,175.66*	*2,800.36*
Duval County CRD	*5.71*	*6.94*	*44.81*
Kleberg County Kaufer-Hubert Memorial Park	*5.15*	*3.19*	*36.96*
Kleberg County	*34.75*	*33.15*	*54.33*
Ticona Polymers	1,821.20	2,162.06	-
San Diego MUD #1	*312.92*	*304.59*	*840.11*
City of Bishop	*115.42*	*162.84*	*358.59*
City of Alice-South Plant	*1,362.06*	*1,510.86*	*2,912.37*
City of Alice- East Plant	*703.62*	*816.72*	*2,262.69*
City of Kingsville	*1,620.68*	*1,573.60*	*3,360.43*
City of Kingsville	*677.55*	*717.97*	*1,120.14*
Total Discharges	**84,663**	**92,327**	**-**

Source: Nueces River Authority's Effluent Monitoring Report for 2018.

[1] These wastewater dischargers are recognized by the Nueces River Authority and the TCEQ as contributors to freshwater inflows to the Nueces Estuary System.

[2] Annual wastewater discharged, in ac-ft, for 2017 and 2018. Total Municipal/Domestic discharges in 2017 – 53,245 ac-ft. Total Industrial Discharges in 2017 – 31,417 ac-ft. Total Municipal/Domestic discharges in 2018 – 59,285.31 ac-ft. Total Industrial Discharges in 2018– 33,041 ac-ft. *Italicized facilities were included in total municipal/domestic discharge calculation.*

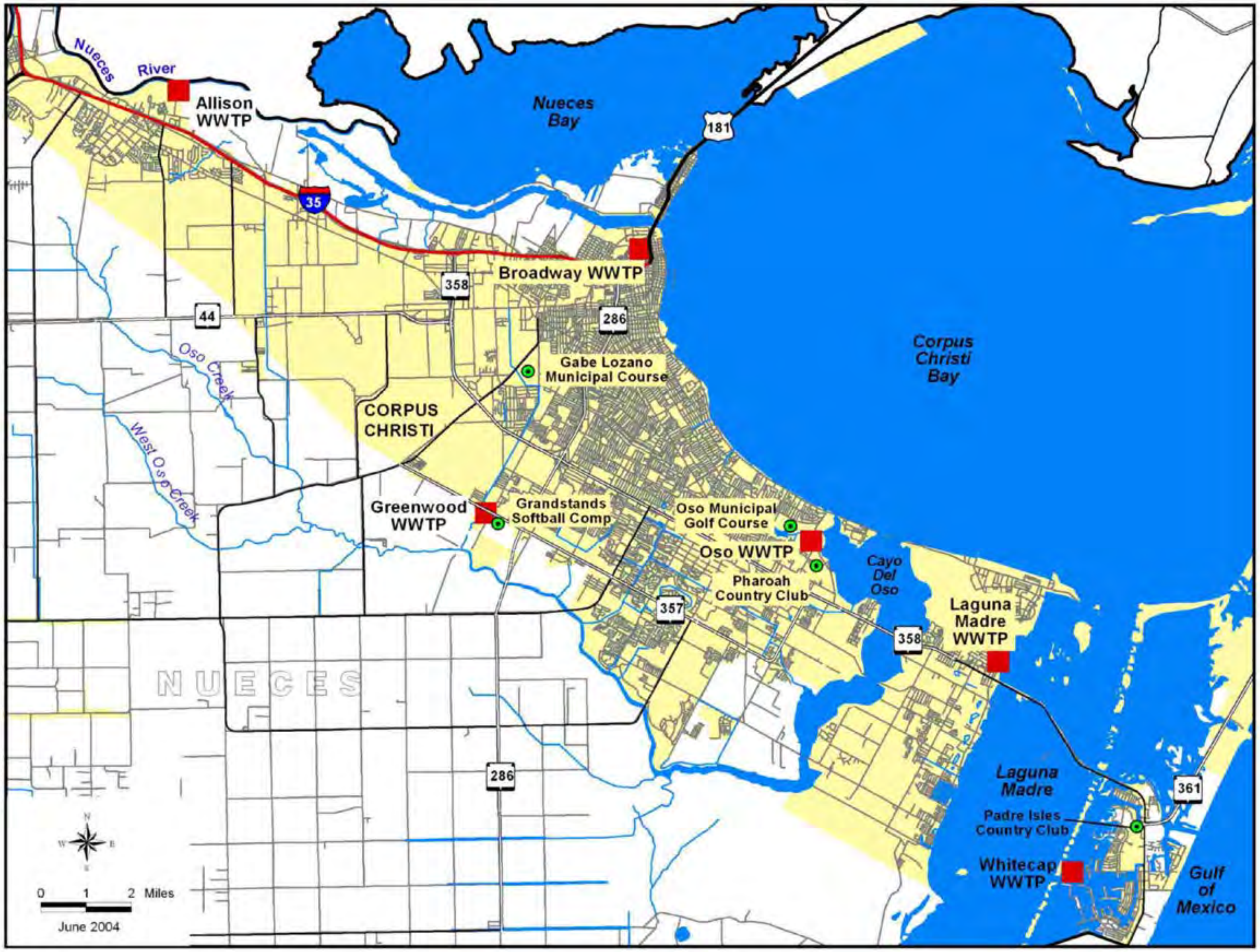

Figure 5D.5.1.
City of Corpus Christi Wastewater Treatment Plants

5D.5.2 Wastewater Reuse Considerations for Municipal and Industrial Purposes

5D.5.2.1 Texas Administrative Code, Chapter 210 – Use of Reclaimed Water

There are two general qualities of treated wastewater allowed for reclaimed water use under TCEQ rules, Chapter 210. These are grouped and defined as Type I and Type II uses.

Broadly defined, Type I reclaimed water quality is required where contact between humans and the reclaimed water is likely. The types of water uses for which Type I reclaimed water could be generally used are:

- Residential irrigation;
- Urban irrigation for public parks, golf courses with unrestricted public access, school yards or athletic fields;
- Fire protection;
- Irrigation of food crops where the reclaimed water may have direct contact with the edible part of the crop;
- Irrigation of pastures for milking animals;
- Maintenance of water bodies where recreation may occur;
- Toilet or urinal flushing; and
- Other similar activities where unintentional human exposure may occur.

Type I water can also be used for all Type II uses listed below.

Type II water quality is where such human contact is unlikely. The types of water uses that would generally be considered as eligible for Type II reclaimed water are:

- Irrigation of sod farms, silviculture, limited access highway rights-of-way, and other areas where human access is restricted (restricted access can include remote sites, fenced or walled borders with controlled access, or the site not being used by the public when normal irrigation operations are in process);
- Irrigation of food crops where the reclaimed water is not likely to have direct contact with the edible part of the crop;
- Irrigation of animal feed crops, other than pasture for milking animals;
- Maintenance of water bodies where direct human contact is unlikely;
- Certain soil compaction or dust control uses;
- Cooling tower makeup water;
- Hydraulic fracking;
- Irrigation or other non-potable uses of reclaimed water at a wastewater treatment facility; and
- Any eligible Type I water uses.

At a minimum, the TCEQ requires that the reclaimed water will be of the quality specified in the rules (Table 5D.5.2).

Table 5D.5.2.
Quality Standards for Using Reclaimed Water (30-day Average)

Type I	
BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	75 CFU/100 mL (single grab sample)
Enterococci	4 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	9 CFU/100 mL (single grab sample)
Type II Other than Pond Systems	
BOD_5	20 mg/L
or $CBOD_5$	15 mg/L
Fecal Coliform	200 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	800 CFU/100 mL (single grab sample)
Enterococci	35 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	89 CFU/100 mL (single grab sample)
Type II Pond Systems	
BOD_5	30 mg/L
Fecal Coliform	200 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	800 CFU/100 mL (single grab sample)
Enterococci	35 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	89 CFU/100 mL (single grab sample)

Source: TAC §210.33 - accessed January 2020
mg/L = milligrams per liter
BOD_5 = Biochemical Oxygen Demand (5-day)
C/BOD_5 = Carbonaceous Biochemical Oxygen Demand (5-day)
CFU/100 ml = Colony Forming Units per 100 milliliter

5D.5.2.2 Industrial Wastewater Reuse

In general, primary industrial customers utilize similar facility processes that are mainly responsible for water consumption, such as cooling towers and boilers. In addition, industry also uses freshwater for drinking water, sanitary use, and equipment washdown and fire protection. The primary differences in water usage, however, are product related. Process requirements influence the size and type of cooling systems and boilers needed for steam production. Process and product differences affect water quantity and quality needs. Depending on the industrial facility's plant size, age, and market conditions, different plants in the same industry category can have different water needs and water use efficiencies.

The petroleum refinery and petrochemical industries produce numerous products such as fuel oil, gasoline, petrochemicals and kerosene. The diverse chemical manufacturing industry served by the City of Corpus Christi water system produces various products such as high quality plastics, weather resistant paints, alumina, chromium compounds, Freon, adhesives, formaldehyde, synthetic resins, and pharmaceuticals. In general, the chemical manufacturing industry requires more water per unit production due to the nature of the chemical manufacturing process and the water content of certain produced chemicals.

In most area industries, heat dissipation is the single largest demand for water within a plant. Typically, water is used to remove heat from process streams. The heated water is cooled by a cooling water system. Cooling water systems in the study area are either recirculating freshwater cooling systems, which use cooling towers, or are once-through cooling systems. Once-through cooling systems in the study area are primarily steam-electric power plants that use very large volumes of seawater to cool the steam (for reuse) required to turn turbines for electric power generation. In order to prevent unacceptable build-up of minerals and salts, a portion of the cooling water from the cooling tower is discharged or blown down. Thus a continuous supply of new water (make-up) is required to supplement the freshwater lost due to evaporation and blow down.

Boiler-feed water is the second largest use of freshwater. This involves heating water to produce steam for process use. Steam is used to add heat to process streams and to power turbines for generating electricity. Steam is also used to drive pumps, compressors and fans, as well as in the process to facilitate fractionation in petroleum refineries and chemical plants. This steam is condensed and returned to the boiler feed water system to be reused.

The third largest industrial use of City water is in the process stream, where water is used as a feedstock, for example, in the reforming process to produce hydrogen in refineries and to scrub air contaminants (cleaning a contaminated airstream with a liquid), in digesters, or for chemical and product separation. The remaining use of freshwater within industry is primarily for drinking water, sanitary use, equipment washdown, and fire protection.

For most chemical and refining plants, cooling accounts for 60 to 75 percent of the water use, boiler water use accounts for 20 to 30 percent, process water accounts for 5 to 9 percent, and potable or sanitary use accounts for 1 percent. Chemical plants typically utilize more water in their process streams and in their products, while refineries, which produce steam for electrical generation, utilize more water for boiler use.

The following factors influence and control current water use, the potential for industrial water conservation, and the potential for area industries to use alternative sources of water, including treated municipal wastewater, brackish groundwater, and seawater. The list of important factors includes:

- The location of each water-using industrial plant in relation to a source or sources of water;
- The location of each water-using industrial plant in relation to streams or other features into which wastewater can be discharged;

- The type of industry, which determines the type of water use (i.e. refineries which use varying and/or different grades of crude petroleum, refineries which are producing reformulated gas, chemical plants which produce a range of chemicals and pharmaceuticals, and plants which extract compounds from ores to produce metals and other products); and
- The metallurgy of equipment in the cooling system that would come in contact with the cooling water.

5D.5.2.3 Current Reuse Projects in the Coastal Bend Region

Municipal and Irrigation Reuse Projects in the Coastal Bend Region

The City of Corpus Christi's current water conservation plan emphasizes education and changes to the water rate structure to promote conservation and reuse. The City of Corpus Christi began its reuse program in the early 1960s, with delivery of reclaimed effluent to the Gabe Lozano Golf Course. The City continued to develop reuse by diverting a portion of its WWTP effluent to certain public facilities for irrigation purposes (i.e. for golf course and park irrigation). Currently, the City has reuse facilities at five of their WWTPs, which serve three golf courses, the Veterans cemetery, Corpus Christi Country Club, and the Naval Air Station.[8] Approximately 2.5% of the City's overall effluent flows are reused as reclaimed water[9]. In 2017, the City delivered 63 million gallons for landscape and irrigation use.

The City completed Oso Plant Effluent Reuse Improvements to include two new golf courses and one sports complex that currently irrigate with potable (municipal) water supplies. The following improvements that were completed by the City included: 1) Oso WWTP Effluent Diversion Pump Station; 2) 18,276 LF of 16" Effluent Distribution Main; 3) 9,905 LF of 16" Effluent Force Main for King's Crossing Lateral; and 4) 3,000 LF of 16" Effluent Force Main for Bill Witt Park Lateral. In addition to the existing reuse projects at Allison WWTP, Greenwood WWTP, Oso WWTP, Laguna Madre WWTP, and Whitecap WWTP, potential effluent to refineries along ship channel from Greenwood WWTP other WWTP sites may be established.

Although an Agreed Order with the TCEQ is in place that requires the City to release a portion of their WWTP effluent into local bay systems as freshwater inflows, it is estimated that from the Oso WWTP alone, there is still an available supply of approximately 7.0 mgd (7,848 ac-ft/yr) that could be used for irrigation while still meeting the pass-through requirements of the TCEQ Agreed Order.

Industrial Reuse Projects in the Coastal Bend Region

The water quality requirements of industry in the area are determined by the water quality constraints for cooling tower make-up, boiler make-up, process water, and potable water. Since water used for cooling tower make-up and boiler make-up are the predominant industrial uses of

[8] Information regarding existing Reuse was provided by the City of Corpus Christi, February, 2013.
[9] City of Corpus Christi Water Conservation Plan, 2019.

water, the opportunities to substitute alternative water sources for cooling towers, and boiler make-up present the greatest potential opportunities to conserve existing freshwater supplies which is discussed in detail in Chapter 5D.3. Because cooling tower make-up can utilize water of poorer quality as compared to the high quality water required in a boiler, the reuse of waste-water effluent in cooling towers provides the best opportunity for this alternative water supply.

The quality of water used by an industry can have numerous impacts on their facilities. Industrial process equipment can degrade, cooling efficiency can be reduced, health and safety problems can develop, and permitted wastewater discharge limits can be exceeded if the water has undesirable qualities. The most frequent water quality problems within industrial water systems are scaling, corrosion, biological growth, fouling, and foaming. In addition, permitted wastewater discharge parameters, as well as cooling tower solid waste characteristics, are influenced by cooling tower water quality. Solid wastes generated from water treatment and control facilities such as cooling tower basin sludge, have characteristics that affect the costs of handling and disposal, triggering new regulatory requirements, and may affect waste minimization programs.

The high degree of purity required for boiler water is critical because it is used to make steam. If water quality is not properly controlled, contamination from minerals such as calcium and magnesium will be deposited on boilers, restricting the transfer of heat to the boiler water. In addition, boiler metal will corrode and deposits in the steam system will adversely affect the other equipment. Water sources, which have higher concentrations of minerals, create a greater potential for requiring costly pretreatment. In response to drought conditions, concerns about rising costs of water, increased regulation and rising costs of wastewater treatment and disposal, and public interest in water conservation, Corpus Christi area industries implemented water conservation and water reuse measures that have significantly reduced quantities of water needed per unit of production. For example, Corpus Christi area petroleum refineries use between 35 and 46 gallons of water per barrel of crude oil refined, while refineries in Houston use 91 gallons, and refineries in Beaumont use 96 gallons.

Major industrial users in the Nueces and San Patricio County area have implemented various water conservation measures in response to drought, particularly during periods of plant expansion. Nueces County Manufacturing and San Patricio Manufacturing are currently utilizing 1,140 ac-ft/yr and 448 ac-ft/yr of direct recycled reuse respectively according to TWDB records based on the maximum reported reuse amount over a recent five year period (2010-2015). Table 5D.5.3 is a list of water conservation measures, which have been implemented by industry as well as future water conservation strategies, including wastewater reuse. In comparison to other Texas industries, the industries in Corpus Christi have one of the best records of water use efficiency based on results of the TWDB's "Pequod Survey".[10]

[10] Texas Industrial Water Usage Survey, Pequod Associates, Inc. and TWDB, Austin, Texas, August 1993.

Table 5D.5.3. Water Conservation Measures - Corpus Christi Area Industry

Current Measures
• Recycling Cooling Tower and Boiler Blowdown • Improved Control Systems • Dry Cooling, Air Cooled Heat Exchangers • More Efficient Drift Eliminators • Changed Washdown Procedures • Automatic Cooling Tower Blowdown • Leak Detection/Repair • Steam Condensate Recovery • Reuse Wastewater Treatment Effluent for Firewater, Cooling Tower Make-up • Cycling-Up Cooling Towers • Stormwater Reuse • Salt Water for Area Washdown • Salt Water Lubrication of Circulating Water Feed Pumps • Reverse Osmosis with Demineralization • Voluntary Water Conservation Planning • Regulatory Requirement to Consider Reuse • Saltwater for Cooling Uniform blending of Lake Texana/Nueces River waters to provide consistently better water quality with less variation in dissolved minerals.
Future Measures
• Increased Evaluation of Alternative Water Sources to Replace Treated City Water • Additional Application of Reverse Osmosis Treatment • Increased Wastewater Treatment Plant Effluent Reuse • Possible Side-Stream Softening • New Process Changes • Additional Steam Leak Repair • New Chemical Treatment Technology • Increased Water Audit by Industry • Possible Water Conservation Incentives • Possible Regulatory or Local Government Water Conservation Planning Goals • Increasing Water Conservation Research and Education • Additional Industry Pursuing Water Conservation Measures

5D.5.3 Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay

5D.5.3.1 Description of Strategy

The San Patricio Municipal Water District (SPMWD) is investigating the feasibility of a regional wastewater system that could provide a supply of recycled water to industrial users. A proposed San Patricio Regional Wastewater System (SPRWS) would divert wastewater from five customer cities, Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay, to a new WWTP. Treated effluent could then be routed to an existing WTP, blended with that plant's effluent, and distributed for industrial reuse. The recycled water project decreases demand on existing freshwater supplies and helps meet water conservation plan requirements for area industries.

In 2018, Alan Plummer Associates, Inc. presented a draft cost evaluation report[11] for the SPRWS based on a preliminary plan[12] for the regional wastewater system. The initial SPRWS plan includes wastewater transfer pipelines, new or refurbished transfer lift stations, a WWTP, and facilities to treat and deliver recycled water to industrial users. The proposed location for the WWTP is a 135-acre plot near SPMWD's WTP complex, as shown in Figure 5D.5.2. In the event that treated water cannot be recycled, the effluent could be discharged south of the site into a ditch that flows into La Quinta Channel and Corpus Christi Bay.

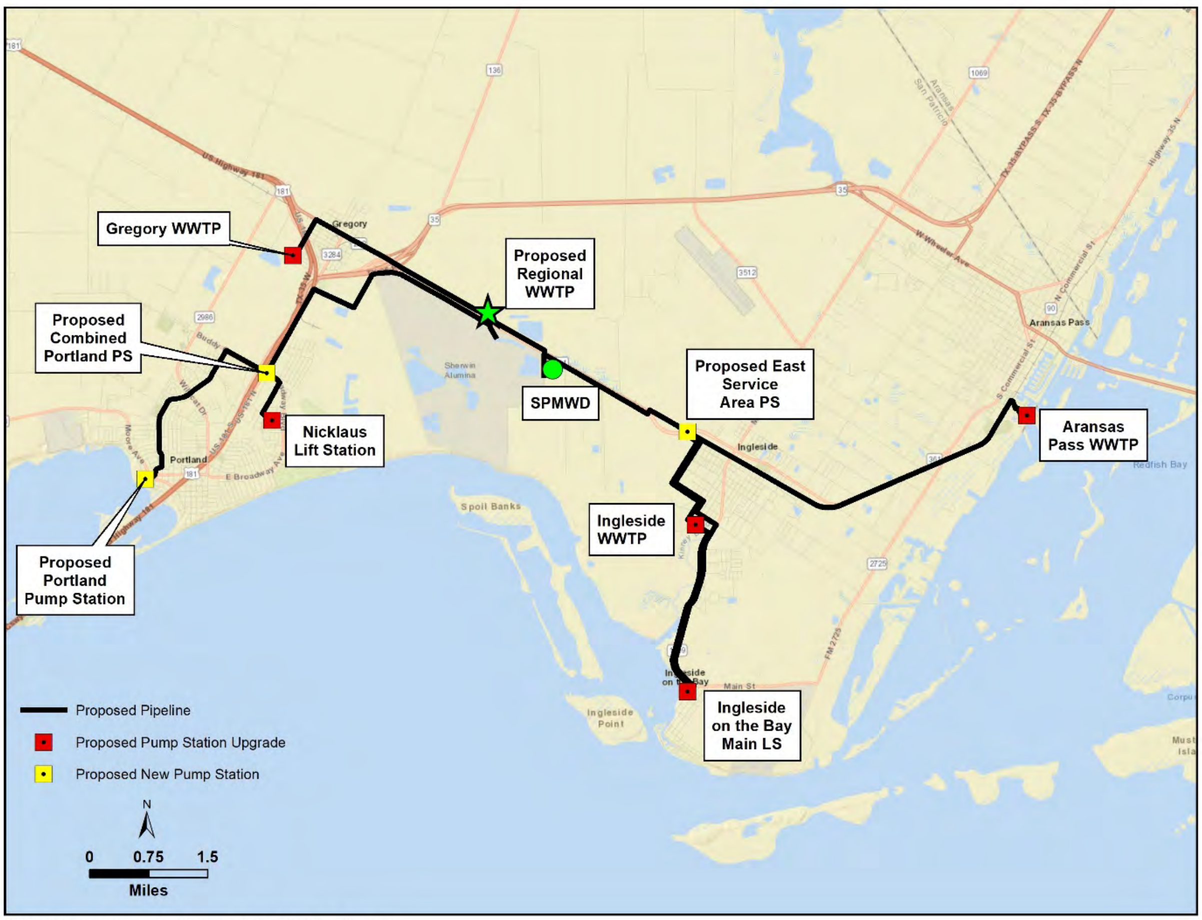

Figure 5D.5.2.
Project Map for Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay

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[11] "San Patricio Municipal Water District Regional Wastewater Treatment Plant Draft Cost Evaluation Report," Alan Plummer Associates, Inc., December 2018.
[12] "San Patricio Municipal Water District Regional Wastewater Treatment Plant Draft Conceptual Report," Alan Plummer Associates, Inc., February 2018.

5D.5.3.2 Available Yield

The draft cost estimate[11] proposed two WWTP capacity options, 6.47 mgd (7,250 ac-ft/yr) or 4.47 mgd (5,010 ac-ft/yr). The larger capacity reflects the combined projected wastewater flow from all customer cities, while the smaller capacity alternative represents the required regional plant capacity if one of the three larger cities does not participate (Portland, Ingleside, or Aransas Pass). Three potential SPRWS pipeline, or influent flow transfer, scenarios were considered. The recommended flow transfer system includes an independent flow transfer from Portland and Gregory and a combined system for Aransas Pass, Ingleside, and Ingleside-on-the-Bay.

5D.5.3.3 Environmental Issues

The proposed SPRWS treatment plant is designed to meet TCEQ reclaimed water regulations along with probable effluent discharge permit limits. The treatment process involves preliminary treatment with fine screens and grit removal, secondary treatment for denitrification and chlorination, and finally dechlorination if effluent is discharged to the Bay. Sludge would be transported to Taft and disposed of at the composting facility.

It has been estimated that between 47 percent and 52 percent of water diverted and used by the City of Corpus Christi and its customers is returned to various points in the estuary as treated wastewater.[13,14] The combined wastewater discharges for Portland, Aransas Pass, Ingleside, and Gregory to Nueces and Corpus Christi Bay was 3,428.41 ac-ft in 2018 (Table 5D.5.1). This alternative involves reusing this treated wastewater for meeting industrial needs near the SPMWD complex. Additional studies are needed to evaluate the environmental impacts near current discharge points that are currently receiving treated effluent. The Coastal Bend Region provides habitat for several endangered species and the resources critical to their continued existence, such as migratory bird use areas, wetlands, and marine fish and invertebrate nursery areas. Because phytoplankton and emergent plants provide food and habitat for animals, especially during early developmental stages, and these in turn provide food for larger animals, changes in primary productivity and plant diversity can be expected to influence the assemblage of animals resident in the estuary. Previous studies indicate that the Nueces Delta and Nueces Bay are critically important as the site of much of the planktonic primary production that drives biological processes throughout the Nueces Estuary.

5D.5.3.4 Engineering and Costing

Overall, the project cost is $137,834,000 for the 6.47 mgd plant capacity and $115,502,000 for the 4.47 mgd plant capacity, which includes construction, engineering, environmental mitigation, and land easement and acquisition[15]. Costs for customer cities, Aransas Pass, Gregory,

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[13] HDR, et al., Op. Cit., September 1995.
[14] 2003 survey results
[15] The Alan Plummer Associates report showed a cost of $114,600,000 for the 6.47 mgd plant, with 15% engineering, land acquisition, and 1.5% testing. Capital costs from the report were used in the cost estimate tables, updated for total project costs to be consistent with RWPG guidelines for all WMS.

Portland, Ingleside, and Ingleside-by-the-Bay, vary based on the percentage of capacity reserved for each city and therefore are not included. Due to uncertainty in which customer city would participate in the smaller plant capacity, the pipeline and integration/relocation/other costs are the same for both. See Table 5D.5.4 and Table 5D.5.5 for a summary of estimated project costs.

Table 5D.5.4.
Cost Estimate Summary for Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay (6.47 MGD)

Item	Estimated Costs for Facilities
Capital Cost	
Transmission Pipeline	$4,700,000
Water Treatment Plant	$62,000,000
Integration, Relocations, and Other	$30,100,000
Total Cost of Facilities	**$96,800,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$33,645,000
Environmental & Archaeology Studies and Mitigation	$1,800,000
Land Acquisition and Surveying	$1,900,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$3,689,000
Total Cost of Project	**$137,834,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$9,698,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$348,000
Total Annual Cost	**$10,046,000**
Available Project Yield (ac-ft/yr)	7,250
Annual Cost of Water ($ per ac-ft)	$1,386
Annual Cost of Water ($ per 1,000 gallons)	$4.25

Note: Costs Provided by SPMWD

Table 5D.5.5.
Cost Estimate Summary for Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay (4.47 MGD)

Item	Estimated Costs for Facilities
Capital Cost	
Transmission Pipeline	$4,700,000
Water Treatment Plant	$45,900,000
Integration, Relocations, and Other	$30,100,000
Total Cost of Facilities	**$80,700,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$28,010,000
Environmental & Archaeology Studies and Mitigation	$1,800,000
Land Acquisition and Surveying	$1,900,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$3,092,000
Total Cost of Project	**$115,502,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$8,127,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$348,000
Total Annual Cost	**$8,475,000**
Available Project Yield (ac-ft/yr)	5,010
Annual Cost of Water ($ per ac-ft)	$1,692
Annual Cost of Water ($ per 1,000 gallons)	$5.19

Note: Costs Provided by SPMWD

5D.5.3.5 Implementation Issues

Between October 2016 and August 2019, The Coastal Bend Bays and Estuaries Program (CBBEP) published four reports with the results of studies in the Corpus Christi and Nueces Bay area:

- Nueces Bay Marsh Restoration- Post Construction Assessment – October 2016
- A Long-Term Seagrass Monitoring Program for Corpus Christi Bay and Upper Laguna Madre, June 2018
- Quantifying Plastic Debris Loading and Accumulation in Corpus Christi Bay to Improve Stakeholder Awareness- August 2018
- Nueces Delta Salinity Effects from Pumping Freshwater into Rincon Bayou 2009 to 2019 - August 2019

No major implementation issues have been identified. TCEQ water quality criteria for reclaimed water will need to be met according to rules (Table 5D.5.2). Project implementation will need to be done to meet with public health standards and protection.

Cultural resources will need to be investigated along the pipeline routes and avoided where possible. Implementation of this alternative should be considered in conjunction with local stakeholders.

5D.5.4 City of Alice Non-Potable Projects

5D.5.4.1 Description of Strategy

The City of Alice operates two wastewater treatment plants. One is centrally located in the north-east side of town and the other is located south of the City. On average, the northeast plant treats approximately 0.7 mgd and the south plant treats 1.1 mgd. These are the flows that would be sustainable for consistent use during a 30-day period. Fluctuations in flow will vary hourly and daily. The City of Alice is considering potential and beneficial uses for non-potable wastewater effluent from the South Wastewater Treatment Plant (WWTP).

5D.5.4.2 Available Yield

Due to the South WWTP proximity to the Airport and Commercial/ Industrial development the reuse of high quality non-potable water could be a viable alternative to the use of drinking water and provide a source for economic development in that area. The anticipated yield of this strategy is 0.8 mgd (897 ac-ft/yr). Figure 5D.5.3 shows the proximity of the South WWTP to industrial end user and a potential south plant pipeline route.

5D.5.4.3 Environmental Issues

The South WWTP currently discharges 100% of its 1.1 mgd effluent into the San Fernando Creek, an intermittent stream that flows about 40 miles to the mouth on Cayo del Grullo. It traverses flat to rolling terrain, surfaced by sandy and clay loam and dark clays that support habitat for grasses, cacti, and mesquite. The reuse project would use the treated effluent that would otherwise discharge to San Fernando Creek. Additional studies to evaluate local environmental impacts should be undertaken prior to project implementation, as the reduced discharge could impact farming and ranching activities.

5D.5.4.4 Engineering and Costing

A cost summary of this option is shown in Table 5D.5.6. As can be seen from this table the estimated unit cost for this option is $1,449/ac-ft or $4.45/1,000 gallons.

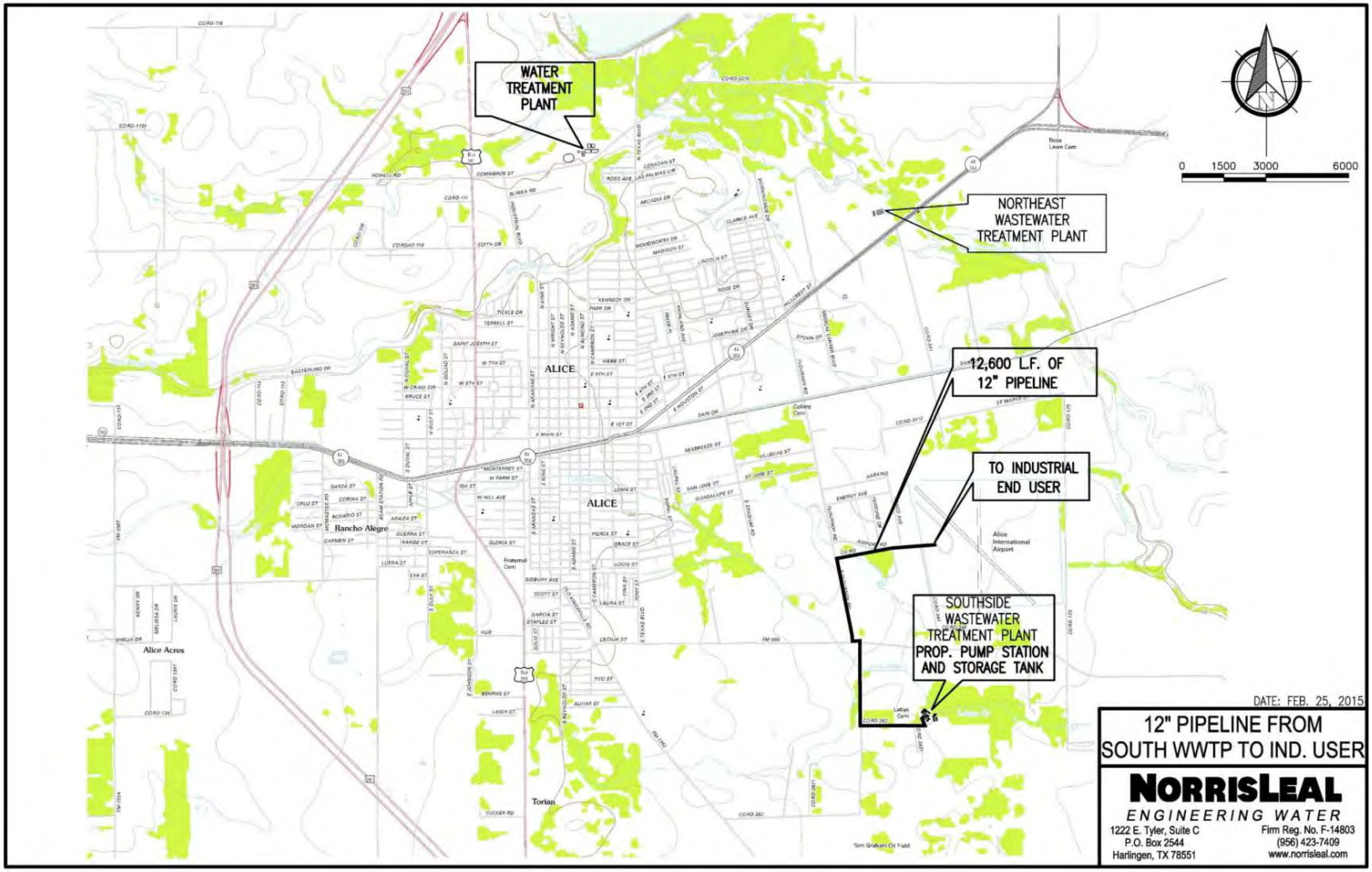

Figure 5D.5.3.
Non-Potable Reuse for Alice

Table 5D.5.6. Cost Estimate Summary - Alice Non-Potable Reuse

Item	Estimated Costs for Facilities
Capital Cost	
Intake Pump Station	$322,000
Transmission Pipeline (12-inch, 13 miles)	$988,000
Transmission Pump Station(s) and Storage Tank(s)	$292,000
Water Treatment Plant 1.1 mgd)	$5,759,000
Total Cost of Facilities	**$7,361,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,527,000
Environmental & Archaeology Studies and Mitigation	$60,000
Interest During Construction (3% for 1 year with a 0.5% ROI)	$274,000
Total Cost of Project	**$10,222,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$719,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tank (1% cost of facilities)	$13,000
Intakes and Pump Stations (2.5% cost of facilities)	$8,000
Water Treatment Plant	$534,000
Pumping Energy Costs (373,925 kW-hr @ 0.08 $/kW-hr)	$26,000
Total Annual Cost	**$1,300,000**
Available Project Yield (ac-ft/yr)	897
Annual Cost of Water ($ per ac-ft)	$1,449
Annual Cost of Water After Debt Service ($ per acft),	$648
Annual Cost of Water ($ per 1,000 gallons)	$4.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.99

Note: Costs Provided by the City of Alice. One or more cost element has been calculated externally.

5D.5.4.5 Implementation Issues

No major implementation issues have been identified for either reuse projects considered. TCEQ water quality criteria for reclaimed water will need to be met according to rules (Table 5D.5.2). Project implementation will need to be done to meet with public health standards and protection.

Cultural resources will need to be investigated along the pipeline routes and avoided where possible. Implementation of this alternative should be considered in conjunction with local stakeholders.

5D.5.5 Evaluation Summary

An evaluation summary of Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay is provided in Table 5D.5.7. An evaluation summary of the City of Alice Non-Potable Reuse project is provided in Table 5D.5.8.

Table 5D.5.7.
Evaluation Summary for Regional Industrial Wastewater Reuse Plan for Aransas Pass, Gregory, Portland, Ingleside, and Ingleside-by-the-Bay

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 5,010 to 7,250 ac-ft/yr
2. Reliability	2. Good.
3. Cost of treated water	3. $1,386 to $1,692 per ac-ft
b. Environmental factors:	
1. Instream flows	1. Potential for environmental impacts to streams currently receiving wastewater effluent.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Environmental impact to estuary in potential reduction of freshwater inflows.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened & endangered species	5. None or low impact.
6. Cultural resources	6. Cultural resources investigations will be required for all pipeline routes.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. The City of Corpus Christi Integrated Plan provides ongoing studies of water quality issues of the Nueces Delta and Bay. a. Dissolved solids are a concern to be addressed with further studies. b. Salinity is a concern to be addressed with further studies. c. Bacteria is a concern to be addressed with further studies. d. Chlorides are a concern to be addressed. e-h. None or low impact. i. Alkalinity may be a concern. Zinc in wastewater discharges into Nueces Bay is a concern to be addressed with further studies.
c. Impacts to Ag and State resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline(s)
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions
g. Interbasin transfers	• None
h. Third party social/ economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides reuse opportunities of water supplies
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Additional care should be exercised in construction of pipeline in dense industrial area.

Table 5D.5.8.
Evaluation Summary for City of Alice Non-Potable Reuse

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 897 ac-ft/yr
2. Reliability	2. Good.
3. Cost of treated water	3. $1,449 per ac-ft
b. Environmental factors:	
1. Instream flows	1. Potential for environmental impacts to streams currently receiving wastewater effluent.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None or low impact. It is not anticipated that current return flows reach Cayo del Grullo.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened & endangered species	5. None or low impact.
6. Cultural resources	6. Cultural resources investigations will be required for all pipeline routes.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a. Dissolved solids are a concern to be addressed with further studies. b. Salinity is a concern to be addressed with further studies. c. Bacteria is a concern to be addressed with further studies. d. Chlorides are a concern to be addressed. e-h. None or low impact. i. Alkalinity may be a concern.
c. Impacts to Ag and State resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline(s)
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions
g. Interbasin transfers	• None
h. Third party social/ economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides reuse opportunities of water supplies
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Additional care should be exercised in construction of pipeline in dense industrial area.

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5D.6

Local Balancing Storage Reservoir (N-6)

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5D.6 5D.6 Local Balancing Storage Reservoir

5D.6.1 Description of Water Management Strategy

The 2021 Coastal Bend Regional Water Plan water management strategies are sized and scheduled to meet seasonal and daily variations of demand. According to TWDB rules, run of the river availability, evaluated for a municipal sole-source water user must be based on a minimum monthly diversion amount that is available 100% of the time during a repeat of the drought of record. Without storage, some current and proposed water supplies may not be fully reliable during extended droughts. In such cases, local balancing reservoirs can store surplus surface water flow that is available during high flow events subject to diversion rates specified in the water rights. This allows a water user to get through drought of record conditions while meeting its water needs. This local balancing storage reservoir WMS involves implementing a surface storage facility for Nueces County WCID #3.

Nueces County WCID #3 has three permits for a combined total of 11,546 ac-ft/yr[1]. Nueces County WCID #3 is a Wholesale Water Provider and provides treated water supplies to the City of Robstown and River Acres WSC. While Nueces County WCID #3 has senior water rights, some dating back to February 1909, it does not have storage provisions. The water right will have to be amended to include the off-channel storage, however the existing authorized diversions from the river will not have to be amended and since they are already authorized they are not subject to TCEQ flow standards. During the worse month of the drought of record, the flow available for diversion is only available to the District's most senior water right[2], CoA 2466_1. In this month, 28 ac-ft out of a 259 ac-ft monthly target for CoA 2466_1 (or 11% of the monthly supply target) is available for diversion resulting in an annual firm supply of 384 ac-ft/yr (11% x 3,500 = 384 ac-ft/yr). No water was available for any of the other two NCWCID water rights for diversion during the minimum month during the drought of record when flow conditions were at a minimum.

For the planning period through 2070, the maximum water demand for Nueces County WCID #3 and its municipal customers is 4,442 ac-ft/yr in 2030 and declines slightly to 4,413 ac-ft/yr by 2070. With a firm yield of 384 ac-ft/yr, Nueces County WCID #3 and its customers have a maximum shortage of 4,058 ac-ft/yr calculated based on minimum flow conditions in the Nueces Basin WAM[3].

This local balancing storage reservoir WMS is recommended for the purpose of storing and recovering surplus supply to meet demands during times of low availability. A balancing storage component that is integrated into the water production and water treatment system has the

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[1] Certificate of Adjudication 2466_1 through 2466_4 for municipal (4,246 ac-ft/yr) and irrigation (7,300 ac-ft/yr) purposes.

[2] Certificate of Adjudication 2466_1 is permitted for 3,500 ac-ft/yr and has a priority date of February 7, 1909. It is the only one of the four water rights for which water is available for diversion during the minimum month of the drought of record. During the worse month of the drought of record (August 1995), the flow available for diversion during the minimum month is only 9% of the total supply needed to meet 2030 water demands.

[3] Based on TWDB rules, run of the river availability was evaluated using the Nueces Basin WAM Run 3 with no return flows. The hydrologic period of the Nueces Basin WAM is from 1934 to 1996. The minimum flow conditions, serving as the basis for shortage calculation, occurred in December 1990.

potential to reduce costs and increase reliability and efficiency of the water management strategies necessary to meet projected need.

5D.6.2 Available Yield

Available yield associated with the local balancing storage was determined using the Nueces River Basin WAM to simulate operations of the run of river rights and water management strategies. The results of the water availability modeling suggested that the minimum month of availability requires an additional 231 ac-ft of supply that could be provided by the balancing reservoir. To address the greatest annual shortage that occurred in July and August 1951, stored water in an amount of 552 ac-ft is required. Considering evaporative losses, a 700 ac-ft capacity local balancing storage reservoir is needed. The projected yield of the strategy is 4,058 ac-ft/yr.

5D.6.3 Environmental Issues

Potential environmental issues associated with implementation of the local balancing storage reservoir includes consideration and mitigation of affected aquatic and terrestrial habitats, cultural resources, and threatened and endangered species, in accordance with applicable state and federal requirements.

5D.6.4 Engineering and Costing

Estimated costs for development of balancing storage assume that 700 ac-ft of storage is needed to meet projected water needs during a repeat of drought conditions and to overcome evaporative losses during this time. The 700 ac-ft storage reservoir is assumed to be approximately 20 feet deep with intake structure sized to refill in one month and infrastructure from storage to the water treatment sized to meet the largest monthly shortage. The pumps are sized based on total storage needed and includes a 6.5-mgd pump station and 18-in diameter piping to terminal storage, and a 4.1-mgd pump station and 16-in pipeline from terminal storage to the water treatment plant. Cost estimates were computed for capital costs, annual debt service, operation and maintenance, power, and land. These costs are summarized in Table 5D.6.1. The project costs, including capital, are estimated to be $21,575,000. As shown, the annual costs, including debt service, operation and maintenance, and power are estimated to be $1,729,000. This option produces raw water at a unit cost of $426 per ac-ft ($1.31 per 1,000 gallons) and treated water[4] at an estimated cost of $794 per ac-ft ($2.44 per 1,000 gallons).

[4] The treatment costs are based on cost estimates for treatment at O.N. Stevens WTP, operated by the City of Corpus Christi.at $368 per ac-ft from the 2016 Plan.

Table 5D.6.1.
Cost Estimate Summary for Local Balancing Storage Reservoir

Item	Costs for Facilities
Capital Cost	
Off-Channel Storage/Ring Dike (Conservation Pool 700 ac-ft, 35 acres)	$5,412,000
Transmission Pipeline (18-inch diameter, 0.5 mile; 16-inch diameter, 0.5 mile)	$653,000
Intake Pump Stations (2) (6.5 and 4.1 mgd)	$8,884,000
Total Cost of Facilities	**$14,949,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,199,000
Environmental & Archaeology Studies and Mitigation	$150,000
Land Acquisition and Surveying (51 acres)	$151,000
Interest During Construction (3% for 2 year with a 0.5% ROI)	$1,126,000
Total Cost of Project	**$21,575,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$957,000
Reservoir Debt Service (3.5 percent, 40 years)	$373,000
Operation and Maintenance	
Pipeline, Wells and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$222,000
Dam and Reservoir (1.5% of Cost of Facilities)	$81,000
Pumping Energy Costs (1,107,948 kW-hr @ 0.08 $/kW-hr)	$89,000
Total Annual Cost	**$1,641,000**
Available Project Yield (ac-ft/yr)	4,058
Annual Cost of Raw Water ($ per ac-ft)	$426
Annual Cost of Raw Water After Debt Service ($ per ac-ft)	$98
Annual Cost of Water ($ per 1,000 gallons)	$1.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.30
Annual Cost of Treated Water ($ per ac-ft), with treatment costs of $369 ac-ft	$794

5D.6.5 Implementation Issues

Potentially significant implementation issues associated with a balancing reservoir include the following:

- Quantification and consideration of any potential effects on water rights, streamflows, and freshwater inflows to bays and estuaries to the extent required by TCEQ rules and applicable state and federal law.
- Run-of-river water rights often require surface storage and/or groundwater to firm up supply for municipal water use and a determination as to the most economically feasible of these is necessary.
- Acquisition of State, Federal, and Local permits.
- Environmental studies.
- Relocations of affected roads, railroads, utilities, and cultural resources.

5D.6.6 Evaluation Summary

It is assumed that Nueces County WCID #3 will implement this strategy to reliably meet the needs of its water supply customers. An evaluation summary of this water management option is provided in Table 5D.6.2.

Table 5D.6.2.
Evaluation Summary of Nueces County WCID #3 Local Balancing Storage Reservoir

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Firm Yield: 4,058 ac-ft/yr
2. Reliability 3. Cost of Treated Water	2. Highly reliable quantity. 3. Cost: $794 per ac-ft. Moderate cost as compared to other strategies.
b. Environmental factors	
1. Instream flows	1. Some impact due to increased diversions from the Nueces River, when available, for terminal storage needs during droughts.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Some impact due to increased diversions from the Nueces River, when available, for terminal storage needs during droughts.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None or low impact.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	
c. Impacts to agricultural resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• None
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

5D.7

Aquifer Storage and Recovery (N-7)

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5D.7 D.7 Aquifer Storage and Recovery (N-7)

5D.7.1 Description of Strategy

Aquifer Storage and Recovery (ASR) is a process whereby treated water is placed into an aquifer for storage to be recovered during a later time when needed. Treated water is normally recharged into the aquifer through well(s). During the recharge and recovery cycles, well screens placed in productive zones for storage allow water to flow through porous areas of the aquifer. The stored water is then recovered and used when water supplies are constrained, such as during drought, periods of high seasonal demands, or water service interruptions. Monitoring wells are used to help maintain a buffer zone within the aquifer between stored and native groundwater and manage storage for supply system operations. ASR can be readily adapted to current infrastructure, delay costly system improvements, and provide supply system redundancy for reliability.

The City of Corpus Christi, in conjunction with the Corpus Christi Aquifer Storage and Recovery Conservation District (District), completed a Corpus Christi ASR Feasibility Project in August 2019. The project was partially funded by a grant from the TWDB to study innovative water solutions to promote long term, cost-effective, reliable water supplies for future growth. The work included (1) developing a field testing approach (2) conducting an exploratory test drilling and sampling program (3) performing a geochemical analysis for source and groundwater compatibility (4) developing a groundwater model and simulating potential ASR operations for long-term drought and supply augmentation during peaking and (5) evaluating ASR operating policies for project implementation. The final report is available on the TWDB website[1]. During the study, both O.N. Stevens WTP and Greenwood WWTP effluent were evaluated as potential supplies. Based on City staff directives, it was determined that Greenwood WWTP effluent was the preferred recharge source due to less competing needs for its use, native groundwater quality considerations, and more frequent availability for recharge than O.N. Stevens WTP water. A conceptual ASR schematic is shown in Figure 5D.7.1.

The Corpus Christi ASR project upcycles treated effluent from the Greenwood Wastewater Treatment Plant (WWTP) for beneficial non-potable water supply for industries during droughts and/or high seasonal demands. Greenwood WWTP effluent is treated and conditioned prior to recharge for storage in the brackish Gulf Coast Aquifer System. After multiple cycles, water quality improves and stored water takes on the characteristics of the recharge water separated by a buffer zone from native groundwater. Based on exploratory testing results, the most favorable ASR storage zones are located between 350 and 800 feet below ground surface. The recovered water quality is anticipated to have total dissolved solids (TDS) and chloride levels around 2,000 mg/L and 750 mg/L, respectively. Based on water quality needs, reverse osmosis treatment can be added to reduce TDS and chloride levels.

[1] https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1600011956_Corpus_Christi_ASR.pdf?d=1581391239865

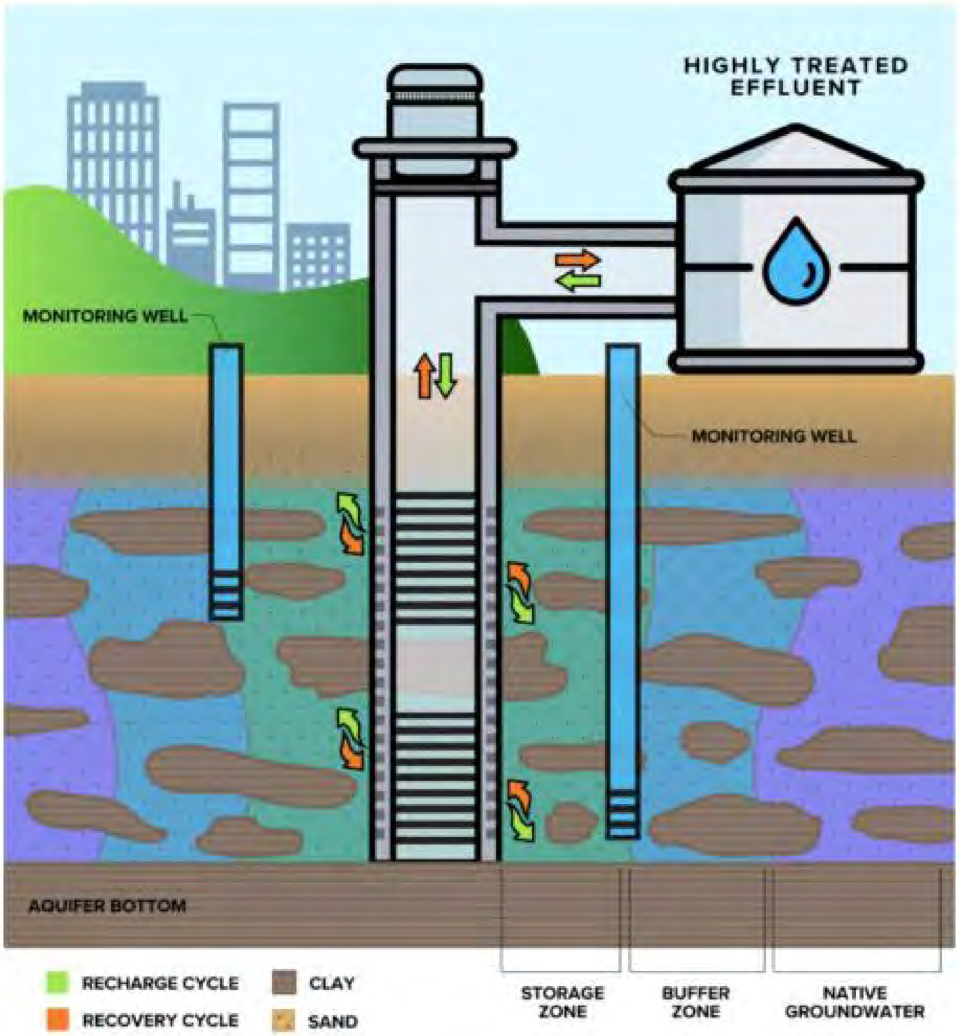

Figure 5D.7.1.
Conceptual ASR Process

For ASR projects, it is important to evaluate source water compatibility with native groundwater and aquifer minerology to avoid adverse mechanical and chemical processes with project implementation. The geochemical analysis did not identify any fatal flaws, however pilot testing of tertiary treatment of WWTP effluent is needed prior to aquifer recharge and monitoring during pilot testing will be critical in proving up geochemical desk-top analyses prior to full scale project implementation and remove suspended materials to avoid clogging the fine sand in aquifer formation for storage. Prior to implementation, a piloting program is needed to verify field tests and confirm water treatment processes necessary to obtain a TCEQ permit for ASR production, which requires that the source water for recharge to be treated to a sufficient quality so as to not impact or impair the aquifer formation or groundwater. The Greenwood WWTP effluent will need to be improved with additional treatment upgrades to reduce the following constituents in the existing effluent that could affect operations:

- Total Suspended Solids (TSS)

- Nitrate (NO_3)
- Total Organic Carbon (TOC)
- Manganese (Mn)
- Bacteria

A field-scale groundwater model was constructed using site-specific data collected during the exploratory testing program. The model was then used to simulate most likely ASR operational scenarios[2] based on source water availability and future water demands in the vicinity of the project site to determine yield. During scenario development, it was determined that industrial water users in the vicinity of the ASR wellfield would be the most likely customers for recovered water. This determination is based on projected future growth and non-potable needs that could be met with ASR supplies with minimal to no treatment anticipated after recovery.

5D.7.2 Available Yield

The Corpus Christi Aquifer Storage and Recovery Project is a phased project, with the initial size based on current Greenwood WWTP capacity and capable of expansion to address industrial growth by providing up to 18 MGD of new water supply.

Phase I is focused on 10 wells at the Corpus Christi International Airport site and Phase II adds 5 wells to the east of Phase I. A schematic showing transmission pipelines, Phase I and II wells and associated well field pipeline, and delivery location is shown in Figure 5D.7.2. Phase I and II operated conjunctively would be capable of providing about 10 MGD from ASR well operation, and up to 18 MGD with Greenwood WWTP expansion[3].

The Phase I and II findings from the Corpus Christi Aquifer Storage and Recovery Feasibility Project are as follows:

Phase I

- Phase I limits recharge to 5 MGD, which is based on current available Greenwood WWTP capacity after considering existing contracts to provide treated effluent to golf courses and would be capable of providing up to 8 MGD through recovery at ASR wells.
- If tertiary treated Greenwood WWTP effluent by-passes ASR and is delivered concurrent with ASR recovery, then the combined water supply would be 13 MGD for Phase I.

Phase II

- Based on City Staff input, Greenwood WWTP will likely be expanded to 10 MGD by 2030 to 2035. With tertiary treatment expansion to 10 MGD, it is assumed that up to 8 MGD would be available for ASR project and/or delivery to industrial customers.

[2] Based on conversations with City Staff and stakeholders
[3] Based on City staff feedback, Greenwood WWTP expansion to 12 MGD by Year 2025-2030 would result in about 8 MGD treated effluent available for potential ASR use.

- Phase I and II operated conjunctively would provide about 10 MGD from ASR well operation, and up to 18 MGD total by-passed water from Greenwood WWTP expansion[4].

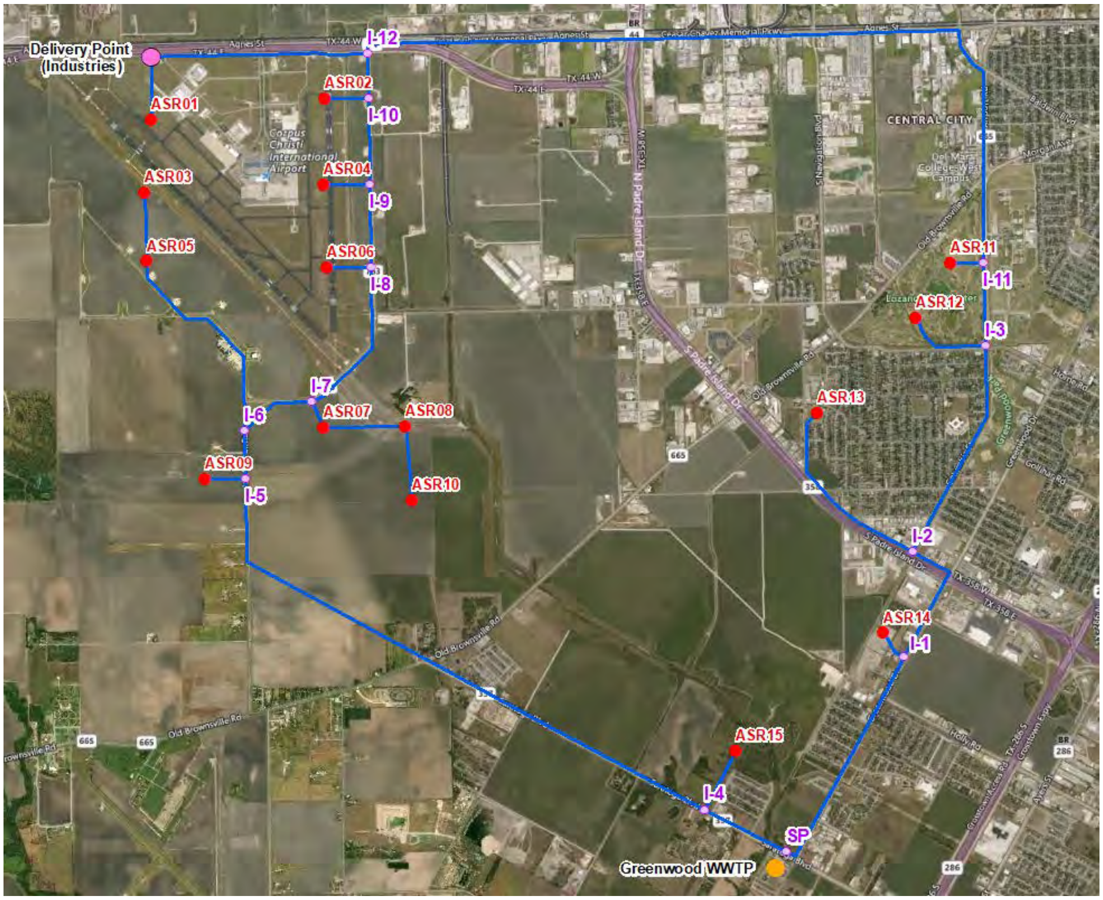

Figure 5D.7.2.
Project Layout of the Corpus Christi ASR Feasibility Project (Phase I and II)

5D.7.3 Environmental Issues

The 2001 Agreed Order includes provisions for 151,000 ac-ft/yr of freshwater inflows to the Nueces Bay and Estuary System, made up with a combination of 54,000 ac-ft return flow credit and remaining 97,000 ac-ft from pass-throughs and controlled releases from the CCR/LCC system according to inflow and stored water levels. The actual wastewater discharges in 2017 and 2018 amounted to 84,663 and 92,327 ac-ft, respectively. It is unlikely that use of Greenwood WWTP effluent as a source water for ASR will have a meaningful impact on achieving freshwater inflow requirements associated with the 2001 Agreed Order.

[4] Based on City staff feedback, Greenwood WWTP expansion to 12 MGD by Year 2025-2030 would result in about 8 MGD treated effluent available for potential ASR use.

The most significant environmental issue associated with this project is repurposing Greenwood WWTP effluent that would otherwise be discharged to Oso Creek. Oso Creek receives treated domestic wastewater from a number of facilities, one industrial facility, three municipal storm sewer systems, four concrete production facilities, and three pesticide plants authorized to discharge. As presented in Table 5D.5.1 (Chapter 5D.5- Reuse), Greenwood WWTP discharged 13,694 ac-ft/yr in 2018. Based on a three year average from January 2015- December 2017, the discharge from Greenwood WWTP was about 5.5 MGD. This represents about 1.7% of the recent discharge to Oso Creek from 2015-2017[5]. Oso Creek (Segment 2485A), is listed[6] to have bacteria impairment and water quality concerns of Chlorophyll-a, nitrates, and total P, as shown in Chapter 1- Planning Area Description Table 1.2. Within the Oso Creek watershed, the most probable sources of bacteria is regulated stormwater, industrial sources, and nonpoint sources.[7] The Texas A&M University at Corpus Christi Center for Coastal Studies and local stakeholders have formed a group to study Oso Creek and in response, the TCEQ adopted a total maximum daily load[8] (TMDL) for Oso Creek on July 31, 2019 to monitor and reduce bacterial loads in Oso Creek. The EPA approved the TMDL on October 25, 2019, and is now part of the state's Water Quality Management Plan. The Texas State Soil and Water Conservation Board is working to decrease bacterial loads from agriculture by assisting landowners in developing and implementing water quality management plans. Additional studies are needed to evaluate the environmental impact of reducing Greenwood WWTP discharge to use as a supply for ASR.

5D.7.4 Engineering and Costing

The ASR project includes two phases (Phase I and II) based on current WWTP treatment capacity and phased according to industrial growth needs. If tertiary treated Greenwood WWTP effluent by-passes ASR and is delivered concurrent with ASR recovery, then the combined water supply would be 13 MGD for Phase I. Phase I and II operated conjunctively would be capable of providing about 10 MGD from ASR well operation, and up to 18 MGD with Greenwood WWTP expansion[9].

The current secondary treatment process at the Greenwood WWTP consists of a conventional, activated sludge treatment system. The system effectively reduces the biochemical oxygen demand (BOD) and nitrifies the influent ammonia. However, augmentations to the secondary treatment system are required to reduce the effluent nitrate (NO3). This process will reduce NO3 to less than 10 mg/L, the maximum contaminant level (MCL). A Modified Ludzack-Ettinger (MLE) process is proposed to complete this treatment. To fully treat the wastewater effluent after the MLE process to sufficient quality to be able to inject it into the aquifer, additional unit processes will likely be required. The main parameters to be reduced or removed in the tertiary system are Manganese (Mn), Total Suspended Solids (TSS), Total Organic Carbon (TOC), and

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[5] Table 5. TCEQ, One Total Maximum Daily Load for Indicator Bacteria in Oso Creek, Adopted July 2019.
[6] Nueces River Authority 2019 Basin Highlights Report: San Antonio-Nueces Coastal Basin, Nueces River Basin, Nueces-Rio Grande Coastal Basin. https://www.nueces-ra.org/CP/CRP/pdfs/2019_BHR.pdf
[7] TCEQ, One Total Maximum Daily Load for Indicator Bacteria in Oso Creek, Adopted July 2019.
[8] https://www.tceq.texas.gov/assets/public/waterquality/tmdl/67osocreekbacteria/67-osocreekbacteria.pdf
[9] Based on City staff feedback, Greenwood WWTP expansion to 12 MGD by Year 2025-2030 would result in about 8 MGD treated effluent available for potential ASR use.

bacteria. Three treatment trains are recommended to be compared during the pilot system which will inform and direct the Phase I and II project construction and later expansion of the treatment plant. The proposed pilot plant arrangement is shown in Figure 5D.7.3.

In the absence of pilot system results, the cost analysis considers secondary treatment improvements and the additional tertiary system considers the following processes:

- Tertiary Membrane Filtration, (TMF or Microfiltration)
- Ozone and Biologically Active Filter (BAF)
- Ozone and BAF with Microfiltration polishing

Microfiltration (TMF)

The standard method for removing suspended particles is typically through a membrane filter. Microfiltration, or Tertiary Membrane Filtration (TMF), through hollow fiber membranes is an efficient system to effectively remove particles larger than 1 µm, which includes most bacteria. The system will use a submerged membrane configuration and be maintained with an air scouring system with periodic cleaning using acid based cleaners. The physical filtration mechanism should efficiently remove TSS and bacteria once the MLE system removes NO_3. Microfiltration treatment will likely not sufficiently remove TOC or dissolved Mn.

Ozone and BAF

Biologically active filters (BAF) operate in a similar way as a traditional slow sand filter. However, a biologically active layer is allowed to develop at the surface of the filter to further treat organic constituents. Ozone is used as an oxidizer before the filter to breakdown recalcitrant TOC that was not available to be processed in the secondary treatment. The biological layer for the BAF will then consume the now biodegradable TOC. An additional benefit of the configuration is that any remaining Mn is expected to be oxidized and removed. Potential inefficiencies of the treatment systems is that the bacteria from the biologically active area may be carried into the effluent and TSS will likely not be sufficiently reduced.

Ozone and BAF with Microfiltration polishing

The combination of the two treatment systems should effectively treat the effluent to a level that will not significantly impact the aquifer environment. All constituents of concern should be removed to meet water quality requirements for ASR injection as detailed previously. This option effectively eliminates individual limitations for the TMF and Ozone/BAF systems.

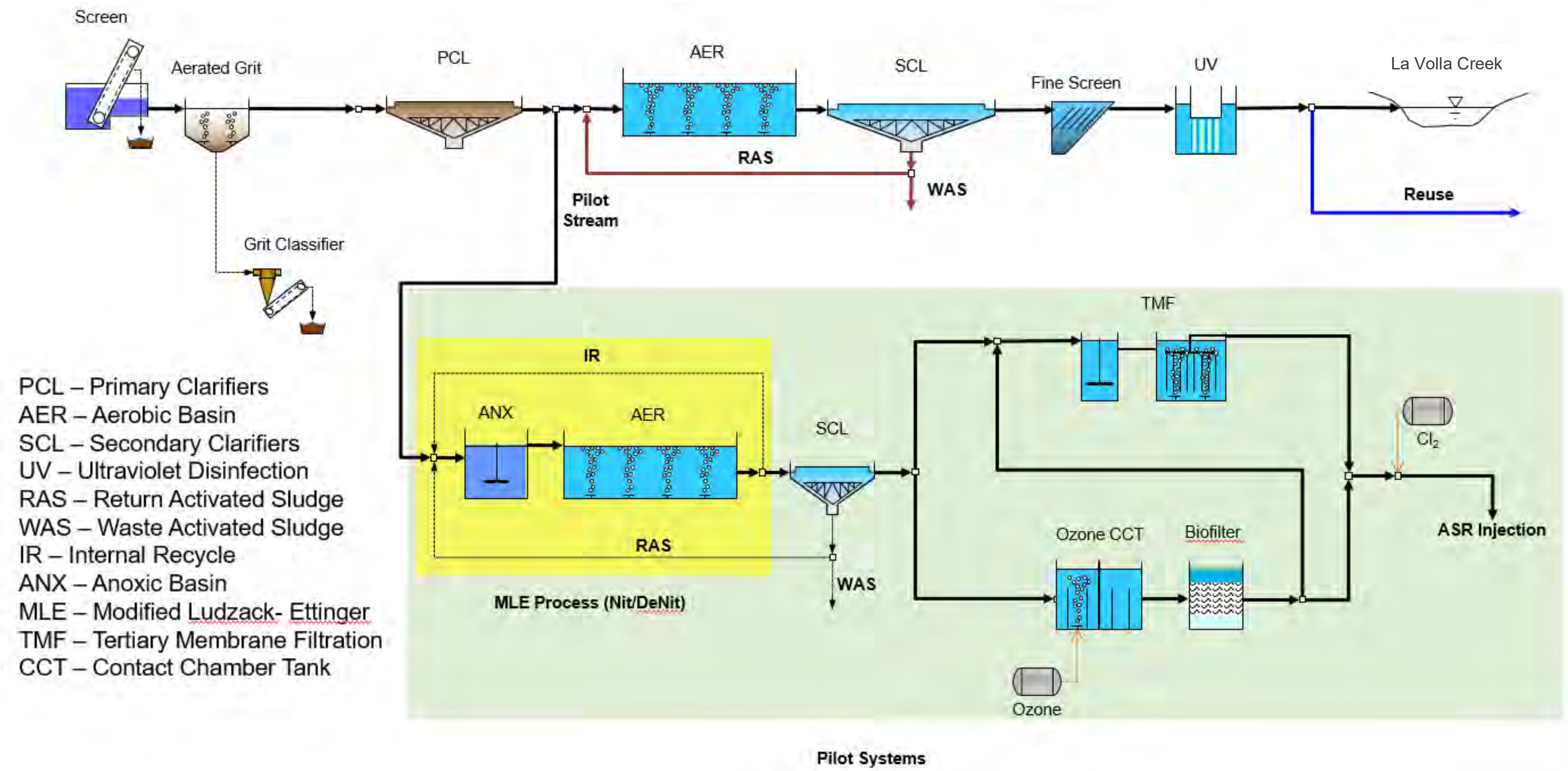

Figure 5D.7.3.
Proposed Pilot System Configuration Process Flow Diagram

5D.7.4.1 Phase I Cost Estimate

The Phase I planning-level cost estimate includes:

- 10 wells constructed and equipped to:
  - Recharge up to 415 gpm each (total 5.976 MGD, or about 20% extra to account for well downtime and/or maintenance)
  - Recover up to 685 gpm each (total 9.8 MGD, or about 23% to account for well downtime and/or maintenance)
- 5 MGD pump station at Greenwood WWTP (for recharge)
- 10.9 MGD booster pump station near Phase I wellfield (for recovery)
- 24-inch transmission pipeline from tertiary treatment facilities at Greenwood WWTP to Phase I well field and 8-inch to 30-inch well field piping
- 30-inch diameter pipe to deliver total Phase I supply produced by 10 wells to a delivery point located to the north west of the Corpus Christi International Airport on Agnes Road, south of the intersection of Bronco Road and Interstate Hwy 44
- 2 MG terminal storage tank
- SCADA estimated at 3% of construction costs
- Easement acquisition of 96 acres at cost of $10,000 per acre
- Survey and geotech costs estimated at $55,000 per mile
- Tertiary treatment (5 MGD)
  - MLE treatment
  - Additional tertiary treatment (low to high)
    - Alternative 2: Ozone + BAF (low)
    - Alternative 3: Ozone + BAF + Microfiltration (high)
- Yields up to 13 MGD during recovery
  - 8 MGD through ASR wellfield operation plus
  - 5 MGD through bypass from tertiary treatment facilities at Greenwood WWTP.

A cost estimate for Phase I wells and transmission pipelines needed for recharge, recovery, and conveyance is shown in Table 5D.7.1. The costs shown represent a range of treatment processes that will be identified during piloting for subsequent refinement of Phase I costs, accordingly.

The total project cost is expected to range from $68,632,000 to $90,199,000 depending on treatment process. The annual cost ranges from $6,979,000 to $8,836,000. The unit cost of water is estimated to be $479 to $606 per ac-ft during recovery, which is the firm yield expected during drought conditions. After adding recharge operations to replenish storage for later recovery, the energy costs increase to $1,633,000. The unit cost increases to $537 to $664 per ac-ft.

Table 5D.7.1. Cost Estimate Summary, City of Corpus Christi - ASR Phase I (Low to High Range Based on Treatment)

Item	Estimated Costs with Ozone + BAF (Low)	Estimated Costs with Ozone + BAF + Microfiltration (High)
Capital Cost		
Greenwood WWTP Pump Station (5 MGD Phase 1)	$3,914,000	$3,914,000
Booster Pump Station(s) & Storage Tank(s) (10.9 MGD Phase 1)	$3,402,000	$3,402,000
Wellfield Piping (13.4 mi (P1), 8 IN - 30 IN dia.)	$13,855,000	$13,855,000
ASR Wells (10 wells, 685 gpm, 700 ft depth)	$11,653,000	$11,653,000
Terminal Storage Tank (2 MG)	$1,516,000	$1,516,000
Tertiary Treatment and MLE Upgrade, 5 MGD	$12,018,000	$27,112,000
SCADA	$1,171,000	$1,624,000
Total Cost of Facilities	**$47,529,000**	**$63,076,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$16,547,000	$21,989,000
Environmental & Archaeology Studies and Mitigation	$548,000	$548,000
Land Acquisition (96 acres (P1))	$964,000	$964,000
Surveying and Geotechnical (22 miles (P1))	$1,207,000	$1,207,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,837,000	$2,415,000
Total Cost of Project	**$68,632,000**	**$90,199,000**
Annual Cost		
Debt Service (3.5 percent, 20 years)	$4,829,000	$6,347,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$297,000	$301,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$147,000	$147,000
Tertiary Treatment (Ozone + BAF)	$913,000	$1,248,000
Pumping Energy Costs (@ 0.08 $/kW-hr)	$793,000	$793,000
Total Annual Cost	**$6,979,000**	**$8,836,000**
Available Project Yield (acft/yr)	14,573	14,573
Capacity Cost ($/gpd)	$5.28	$6.94
Annual Cost of Water ($ per acft), during recovery	$479	$606
Annual Cost of Water After Debt Service ($ per acft), during recovery	$148	$171
Annual Cost of Water ($ per 1,000 gallons), during recovery	$1.47	$1.86
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$0.45	$0.52

5D.7.4.2 Phase II Cost Estimate

The Phase II planning-level cost estimate includes:

- 15 wells constructed and equipped to:
  - Recharge up to 415 gpm each for Phase I wells and 500 gpm for Phase II wells (total 9.6 MGD, or about 30% for well downtime and/or maintenance)
  - Recover up to 685 gpm each for Phase I wells and 750 gpm for Phase II wells (total 15.3 MGD to account for well downtime and/or maintenance)
- 10 MGD pump station at Greenwood WWTP (for recharge)
- 17 MGD booster pump station(s) total
- Phase I pipelines + 12-inch transmission pipeline from tertiary treatment facilities at Greenwood WWTP to Phase II well field and well field piping
- 30-inch diameter pipe to deliver total Phase II supply to a delivery point located to the north west of the Corpus Christi International Airport on Agnes Road, south of the intersection of Bronco Road and Interstate Hwy 44
- Two- 2 MG terminal storage tanks (4 MG total)
- SCADA estimated at 3% of construction costs
- Land acquisition of 155 acres at cost of $10,000 per acre
- Survey and geotech costs estimated at $55,000 per mile
- Tertiary treatment (10 MGD, total)
  - MLE treatment
  - Additional tertiary treatment (low to high)
    - Alternative 2: Ozone + BAF (low)
    - Alternative 3: Ozone + BAF + Microfiltration (high)
- Yields up to 18 MGD during recovery
  - 10 MGD through ASR wellfield operation plus
  - 8 MGD through bypass from tertiary treatment facilities at Greenwood WWTP after expansion.

A cost estimate for Phase II wells and transmission pipelines needed for recharge, recovery, and conveyance of water to the delivery point for industrial customer use is shown in Table 5D.7.2. Similar to Phase I, the costs shown represent a range of treatment processes that will be identified during piloting for subsequent refinement of Phase I costs, accordingly.

The total project cost is expected to range from $123,253,000 to $174,668,000 depending on treatment process. The annual cost ranges from $12,189,000 to $16,383,000. The unit cost of water is estimated to be $604 to $812 per ac-ft during recovery, which is the firm yield expected during drought conditions. After adding recharge operations to replenish storage for later recovery, the energy costs increase to $1,824,000. The unit cost increases to $646 to $854 per ac-ft.

Table 5D.7.2.
Cost Estimate Summary,
City of Corpus Christi - ASR Phase II (Low to High Range Based on Treatment)

Item	Estimated Costs with Ozone + BAF (Low)	Estimated Costs with Ozone + BAF + Microfiltration (High)
Capital Cost		
Greenwood WWTP Pump Station (10 MGD Phase II)	$5,689,000	$5,689,000
Booster Pump Station(s) & Storage Tank (16.9 MGD, 500 HP Phase II)	$4,778,000	$4,778,000
Wellfield Piping (24.5 mi (P1+2), 8 IN - 30 IN dia.)	$23,517,000	$23,517,000
ASR Wells (15 wells, 685-750 gpm, 700-800 ft depth)	$18,190,000	$18,190,000
Terminal Storage Tank (4 MG)	$3,033,000	$3,033,000
Tertiary Treatment and MLE Upgrade, 10 MGD	$28,654,000	$64,641,000
SCADA	$2,202,000	$3,281,000
Total Cost of Facilities	**$86,063,000**	**$123,129,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$29,806,000	$42,779,000
Environmental & Archaeology Studies and Mitigation	$791,000	$791,000
Land Acquisition (155 acres (P1+P2))	$1,553,000	$1,553,000
Surveying and Geotechnical (32 miles (P1+P2))	$1,741,000	$1,741,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$3,299,000	$4,675,000
Total Cost of Project	**$123,253,000**	**$174,668,000**
Annual Cost		
Debt Service (3.5 percent, 20 years)	$8,672,000	$12,290,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$485,000	$496,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$222,000	$222,000
Tertiary Treatment	$1,825,000	$2,390,000
Pumping Energy Costs (@ 0.08 $/kW-hr)	$985,000	$985,000
Total Annual Cost	**$12,189,000**	**$16,383,000**
Available Project Yield (acft/yr)	20,178	20,178
Capacity Cost ($/gpd)	$6.84	$9.70
Annual Cost of Water ($ per acft), during recovery	$604	$812
Annual Cost of Water After Debt Service ($ per acft), during recovery	$174	$203
Annual Cost of Water ($ per 1,000 gallons), during recovery	$1.85	$2.49
Annual Cost of Water After Debt Service ($ per 1,000 gal), recovery	$0.53	$0.62

5D.7.5 Implementation Issues

The state rules governing most facets of ASR project implementation in Texas are administered by the Texas Commission on Environmental Quality (TCEQ) and are contained in Title 30 of the Texas Administrative Code (30 TAC), Chapter 331, Underground Injection Control (UIC). The TCEQ has primacy from the US EPA to regulate most injection wells through the Texas UIC Program. Since the proposed ASR project does not currently contemplate recovery of water directly to a public water system, rules related to public supply wells and groundwater sources and development, as contained in 30 TAC §290.41 (c), do not apply. Of particular relevance to the proposed ASR project are the requirements in 30 TAC§331.186 (a), which outlines the criteria to be consider by TCEQ in authorizing ASR operations. The effluent from the Greenwood WWTP does not currently meet drinking water standards for chloride, TDS, manganese, and nitrate concentration, or pathogen removal. While it is anticipated that nitrate and manganese will likely be below the drinking water maximum contaminant limit after tertiary treatment, the other parameters will not be significantly altered prior to recharge. As such, the City will need to demonstrate to the TCEQ that proposed ASR well operations will not: 1) render the groundwater produced from the receiving formation harmful or detrimental to people, animals, vegetation, or property, or 2) require an unreasonably higher level of treatment of the groundwater produced from the receiving geologic formation than is necessary for the native groundwater in order to render the groundwater suitable for beneficial use.

For most previous ASR applications, TCEQ has required treatment to drinking water standards prior to recharge but newer rules passed in 2015 and described in Section 5 of Exhibit G may give some flexibility since both the quality of the effluent relative to drinking water is considered along with the potential to degrade the native groundwater. This project would improve the native groundwater for constituents more relevant to Safe Drinking Water Act as a result of the tertiary treatment prior to injection that address the constituents above MCL. Although the storage aquifer is considered brackish it would still be classified as an underground source of drinking water (USDW) per Title 40, Code of Federal Regulations (40 CFR) Section 144.3. It is likely that additional treatment at the WWTP may be required by TCEQ to meet MCLs, and could be necessary to maintain ASR operations and water compatibility. Treatment may include modifications to the WWTP's treatment process to promote de-nitrification, reduce turbidity, and improve the disinfection system to further inactivate bacteria.

There are several existing wells identified within the ASR study area that will likely be impacted by ASR implementation. Additional efforts to survey unregistered wells in the vicinity of the proposed ASR well field area would be helpful to identify wells to monitor and/or mitigate in advance of commencing ASR operations. Supply protection is within the jurisdictional authority of the District as detailed in the District's 2019 Groundwater Management Plan[10].

[10] http://www.twdb.texas.gov/groundwater/docs/GCD/ccasrcd/CCASRCDMgmtPlan2019.pdf?d=1581392749650

5D.7.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.7.3.

Table 5D.7.3.
Evaluation Summary of City of Corpus Christi ASR Project

Impact Category	Comment(s)
a. Water Supply	
1 Quantity	1. Firm Yield: 14,573 ac-ft/yr (Phase I) and 20,178 ac-ft/yr (Phase II)
2. Reliability 3. Cost of Treated Water	2. Reliable, based on system operations 3. Non-Potable cost: $479- $606 per ac-ft (Phase I) and $604- $812 per ac-ft (Phase II)
b. Environmental factors	
1. Instream flows	1. Low impact. Reduced flow in Oso Creek.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a. Dissolved solids are estimated to be around 2,000 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. b. Salinity are addressed for non-potable use. If water use needed is potable, additional treatment will be required. c. Bacteria is addressed with treatment process. d. Chlorides are estimated to be around 750 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. e-h. None or low impact i. Nitrate, TSS, TOC, and Mn addressed with treatment processes.
c. Impacts to agricultural resources and State water resources	• Reduce discharge to Oso Creek.
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Reduce discharge to Oso Creek.
i. Efficient use of existing water supplies and regional opportunities	• Reuses water supply and compatible with regional development.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

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5D.8

Gulf Coast Aquifer Supplies (N-8)

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5D.8 Gulf Coast Aquifer Supplies

The Gulf Coast Aquifer underlies all 11 counties within the Coastal Bend Region and yields moderate to large amounts of fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five water-bearing formations: Catahoula, Jasper, Burkeville Confining System, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water-bearing formations, are the most productive and, consequently, are the formations utilized most commonly. The Evangeline Aquifer of the Gulf Coast Aquifer System features the highly transmissive Goliad Sands. The Chicot Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Coastal Bend Area. The Burkeville Confining System is a limited water-bearing formation and characterized as containing substantial amounts of clay.

The Gulf Coast Aquifer is the primary groundwater resource in the Coastal Bend Region and estimated to constitute 97 percent of the region's groundwater availability according to Modeled Available Groundwater (MAG) values developed by the TWDB. The MAGs used to define groundwater availability for regional water planning were developed based on desired future conditions adopted by local groundwater conservation districts represented in Groundwater Management Area (GMA) 13, GMA 15, and GMA 16.[1] Table 5D.8.1 shows the Gulf Coast Aquifer groundwater availability, projected use by current groundwater users, and estimates on remaining groundwater available for water management strategies. This information serves as a basis for recommended water management strategies which must be MAG-limited according to TWDB guidelines for regional water planning.

[1] McMullen County is located in GMA 13. Aransas and a portion of Bee County are located in GMA 15. The remaining Region N counties (Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio) are located in GMA 16.

Table 5D.8.1.
Summary of Gulf Coast Aquifer Supplies in the Coastal Bend Region[1]

County Name	Basin Name	MAG (ac-ft/yr)		Groundwater Use (ac-ft/yr)[2]		Amount Available for WMS (ac-ft/yr)	
		2020	2070	2020	2070	2020	2070
Aransas	San Antonio-Nueces	1,542	1,542	404	371	1,138	1,171
Bee	San Antonio-Nueces	17,640	19,951	7,409	7,408	10,231	12,543
Bee	Nueces	797	1,022	359	340	438	682
Brooks	Nueces-Rio Grande	5,582	7,892	3,349	3,562	2,233	4,330
Duval	Nueces	326	428	324	324	2	104
Duval	Nueces-Rio Grande	20,245	26,535	6,438	6,576	13,807	19,959
Jim Wells	Nueces	593	593	430	430	163	163
Jim Wells	Nueces-Rio Grande	8,551	10,424	3,465	3,907	5,086	6,517
Kenedy	Nueces-Rio Grande	13,301	29,261	1,039	1,025	12,262	28,236
Kleberg	Nueces-Rio Grande	10,365	18,711	8,156	9,247	2,209	9,464
Live Oak	San Antonio-Nueces	41	41	0	0	41	41
Live Oak	Nueces	8,297	8,400	4,675	4,114	3,622	4,286
McMullen[3]	Nueces	510	510	510	510	0	0
Nueces	San Antonio-Nueces	0	0	0	0	0	0
Nueces	Nueces	727	845	701	727	26	118
Nueces	Nueces-Rio Grande	5,862	7,079	2,213	2,251	3,649	4,828
San Patricio	San Antonio-Nueces	39,481	43,615	14,608	14,701	24,873	28,914
San Patricio	Nueces	4,130	5,619	1,775	1,789	2,355	3,830
Region N Gulf Coast Aquifer Availability (ac-ft/yr)		**137,990**	**182,468**	**55,855**	**57,282**	**82,135**	**125,186**
Total Region N Groundwater Availability (includes McMullen County- Carrizo and Minor Aquifer)[1,3]		**145,269**	**187,096**	**59,985**	**58,455**	**85,284**	**128,641**

[1] Additional groundwater is available (MAG) for the Carrizo Aquifer and Minor Aquifer Systems (Queen City and Sparta) in McMullen County. These MAGs represent less than 5% of the groundwater supply in the region.

[2] Groundwater use is based on well capacity, infrastructure limits, projected demand, and other factors limited by MAG as discussed in Chapter 3.

[3] Not included in table above- McMullen County has MAG of 7,056 ac-ft/yr from the Carrizo Aquifer and 223 ac-ft/yr from minor aquifers in McMullen County (Queen City and Sparta) in 2020.The MAG for the Carrizo in McMullen County declines to 4,405 ac-ft/yr and remains constant at 223 ac-ft/yr for minor aquifers through 2070. The Yegua Jackson Aquifer, minor aquifer, is present in McMullen County but MAG was not identified for this aquifer by the TWDB. Groundwater use in 2020 is 3,907 ac-ft/yr for the Carrizo Aquifer in 2020 declining to 950 ac-ft/yr by 2070 due to declining water demands for users relying on this supply. Groundwater use in 2020 is 223 ac-ft/yr for Queen City and Sparta Aquifers and stays constant through 2070. No WMS are recommended for the Carrizo, Queen City, or Sparta Aquifers.

5D.8.1 Groundwater Alternative for Municipal Rural Water Systems, Irrigation, Manufacturing, and Mining Water Users for the Coastal Bend Region

5D.8.1.1 Description of Strategy

Municipal water systems and other water user groups (WUGs) in the Coastal Plains area of the Coastal Bend Water Planning Region commonly use the Gulf Coast Aquifer for their supply. These sources may be a strong preference because the water is usually readily available, inexpensive, and often suitable for public water supplies with minimal treatment, although elevated concentrations of TDS are present in some areas.

The purposes of this option are to:

- Evaluate aquifers and existing well field(s) of each WUG to meet projected water supply requirements through the year 2070, based on groundwater supply estimates derived from reported well capacity for other wells in the area.
- If additional supplies are needed, identify whether or not additional wells are the most likely water management strategy, or whether an alternative strategy, such as purchase from a wholesale water provider, is recommended.
- If the water needs to be treated, estimate when the expansion is needed and how much the facilities will cost.

The evaluation of individual WUG systems is at a reconnaissance level and does not include:

- An engineering analysis of the water system as to the current condition or adequacy of the wells, transmission system, and storage facilities;
- A projection of maintenance costs or replacement costs of existing wells and facilities;
- The potential interference of new wells installed by others near the WUG's wells or at locations identified for new well fields;
- Impact of potential changes in groundwater use patterns in the vicinity of the WUG's well field and the county;
- Changes in rules and regulations that may be developed and implemented by a ground-water conservation district or the State; nor
- Consideration of additional wells or water treatment for local purposes such as reliability, water pressure, peaking capacity, and localized growth.

The evaluation of each WUG consists of the following steps:

1. Compiling information prepared for the CBRWPG on current and projected population and water demand for each of the WUGs;

2. Estimated well depth and capacity for each WUG based on publicly available information for the water system from published groundwater reports and TCEQ PWS and TWDB records. For non-municipal groundwater users with groundwater capacities not readily obtained from publicly available resources, the groundwater supply was calculated based on TWDB historical water use records. The final step in determining groundwater supplies was to compare the MAG-preserved well capacities for each WUG that has historically relied on groundwater to projected demands. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower.;

3. If the estimated groundwater supply after adjustments was greater than the estimated groundwater demand in the year 2070 and within the MAG, the evaluation concludes that the existing water supply is adequate;

4. If the estimated supply after adjustments was less than the estimated groundwater demand in the year 2070 and within the MAG, the evaluation concluded that an additional water supply would be needed and that supplies up to the MAG are available to meet needs; and

5. If new wells are the most feasible water management strategy, estimated at what decade it is needed and the capital cost of adding the new wells to the water system.

The methodology presented in the following text focuses on those entities that show a projected need that is likely to be met through development of local groundwater supplies; in other words, only those entities whose needs exceed the current estimation of local, currently accessible groundwater. The entities that have historically relied on groundwater supplies and report a need during the 2020 to 2070 planning period include:

- Bee County-Other (Municipal)
- El Oso WSC
- Bee County- Irrigation
- Bee County- Mining
- TDCJ Chase Field
- Brooks County-Other (Municipal)
- Brooks County- Mining
- Duval County-Other (Municipal)
- Duval County- Mining
- Duval County- San Diego MUD 1
- Jim Wells County-Other (Municipal)
- Jim Wells County- Irrigation
- Jim Wells County- Manufacturing
- Jim Wells County- Mining
- Kenedy County- Mining
- Kleberg County- Manufacturing
- Kleberg County- Mining
- Live Oak County- Irrigation

- Live Oak County- Manufacturing
- Nueces County- Other (Municipal)
- Nueces County- Irrigation
- Nueces County-Mining
- San Patricio County- Irrigation
- San Patricio County- Mining

Because no specific project data regarding any of the local groundwater supply water management strategies is available, it is necessary to make a number of assumptions for costing and evaluation. For WUGs with needs to be met and/or recommended groundwater projects from local Gulf Coast Aquifers, characteristic well depth and well capacity (gpm) estimates were developed for costing purposes based on data from existing wells in the vicinity. For mining groundwater use, it was assumed that groundwater would be supplied at a constant annual rate, and that the water would be usable without treatment. For irrigation, it was assumed that all use would occur in 6 months of the year, so a peaking factor of two was used in estimating the number of wells necessary for cost estimation. In addition, it was assumed that irrigation and mining water would be applied without treatment. No pipelines or pump stations were assigned for costing purposes. It was assumed that these proposed wells would connect directly to the demand center or local distribution system, and that the cost of any associated piping would be covered in the 35 percent project cost contingency factor. For the purposes of estimating well pumping power costs, typically a total dynamic head estimate of 300 feet was assumed — 160 feet to bring water from pumping levels to the ground surface and 140 feet to pump into a pressurized distribution system maintained at 60 psi. This conservative estimate is intended to account for local drawdown and declining water levels with time. For municipal (and county-other) users it was also assumed, in the absence of any specific information to the contrary, that disinfection would be the only treatment needed for the groundwater supply to meet water quality standards, and that adequate treatment capacity would exist to meet peak demand rates.

All cost estimates were performed according to the TWDB's unified costing tool methodology for regional water planning. Costs were amortized over a 20-year loan period, with debt service and annualized O&M often being a significant proportion of costs. In addition, wells are costed according to September 2018 pricing, even if they are not scheduled to be needed until later decades. This is to maintain consistency in cost estimates with other projects. However, it should be noted that individual wells are not usually financed in this manner, and managers of affected WUGs may be more interested simply in the estimated capital cost for the wells. Also, cost estimates for new wells serving economic activities such as mining or irrigation are presented as a group with a single unit cost, although in reality these costs will be borne individually by multiple independent parties (farmers, mining operations, manufacturing plants, etc.) when and where the wells are needed and constructed.

5D.8.1.2 Available Yield

All groundwater development alternatives for small municipal and rural water systems, irrigation, and mining water users in the Coastal Bend Region were limited by MAGs and voluntary groundwater transfers available. Table 5D.8.2 displays the projected needs, by decade, for each of these entities, project yield, and number of wells estimated to be needed to meet shortages identified.

Table 5D.8.2.
Region N Local Needs and Gulf Coast Aquifer Supply Yield Summary

Water User Group	County	Projected Needs (ac-ft/yr)						Maximum Shortage (2020-2070) (acft/yr)	Project Yield (acft/yr)	Total Wells
		2020	2030	2040	2050	2060	2070			
County-Other	Bee	(1,657)	(1,682)	(1,675)	(1,656)	(1,654)	(1,654)	(1,682)	1,682	6
El Oso WSC	Bee	(94)	(94)	(94)	(94)	(90)	(90)	(94)	94	1
Irrigation	Bee	(352)	(352)	(352)	(352)	(352)	(352)	(352)	352	2
Mining	Bee	(197)	(185)	(158)	(109)	(79)	(62)	(197)	197	1
TDCJ Chase Field*	Bee	(177)	(203)	(208)	(204)	(203)	(203)	(208)	208	1
County-Other	Brooks	(192)	(214)	(237)	(265)	(292)	(309)	(309)	309	2
Mining	Brooks	(179)	(182)	(162)	(146)	(130)	(120)	(182)	182	1
County-Other	Duval	(477)	(484)	(490)	(497)	(508)	(516)	(516)	516	4
Mining	Duval	(712)	(768)	(676)	(565)	(489)	(428)	(768)	768	6
San Diego MUD 1	Duval	(288)	(315)	(338)	(365)	(392)	(417)	(417)	417	4
County-Other	Jim Wells	(2,058)	(2,164)	(2,266)	(2,395)	(2,525)	(2,650)	(2,650)	2,650	21
Irrigation	Jim Wells	(333)	(333)	(333)	(333)	(333)	(333)	(333)	333	3
Manufacturing	Jim Wells	0	(16)	(16)	(16)	(16)	(16)	(16)	16	1
Mining	Jim Wells	(52)	(55)	(36)	(21)	(7)	(1)	(55)	55	1
Mining	Kenedy	(58)	(63)	(32)	(8)	0	0	(63)	63	1
Manufacturing	Kleberg	0	(247)	(247)	(247)	(247)	(247)	(247)	247	1
Mining	Kleberg	(139)	(142)	(122)	(106)	(90)	(80)	(142)	142	1
Irrigation	Live Oak	(343)	(534)	(534)	(534)	(534)	(534)	(534)	534	4
Manufacturing	Live Oak	0	(28)	(28)	(28)	(28)	(28)	(28)	28	1
County-Other	Nueces	(1,245)	(1,356)	(1,430)	(1,435)	(1,417)	(1,364)	(1,435)	1,435	8
Irrigation	Nueces	(51)	(51)	(51)	(51)	(51)	(51)	(51)	51	1
Mining-Nueces	Nueces	(629)	(749)	(836)	(905)	(1,006)	(1,127)	(1,127)	1,127	6
Irrigation	San Patricio	(204)	(204)	(204)	(204)	(204)	(204)	(204)	204	2
Mining	San Patricio	(237)	(286)	(305)	(325)	(357)	(398)	(398)	398	2

*Note: Garza East Transfer facility, one of two units on former Chase Field, closed in May 2020. The projected needs shown above are based on TWDB adopted water demands and current supplies and do not take into consideration the closure of the Garza East facility which formerly housed approximately 2,000 inmates.

Evaluation of Additional Groundwater for Municipal Systems with Reported Needs

The following rural municipal water systems rely completely on local groundwater supplies and report a water need during the planning period:

- Bee County-Other (Municipal)
- El Oso WSC (Bee/Live Oak Counties);
- TDCJ Chase Field (Bee County)
- Brooks County-Other (Municipal)
- Duval County-Other (Municipal)
- San Diego MUD 1 (Jim Wells/Duval Counties)
- Jim Wells County-Other (Municipal); and
- Nueces County- Other (Municipal).

Evaluation of Additional Groundwater for Entities with Reported Needs

For purposes of this alternative, additional groundwater development for water user groups are considered in strict accordance with groundwater availability (MAG) and assumes minimal treatment, if any is required.

5D.8.1.3 Environmental Issues

The pumping of groundwater from the Gulf Coast Aquifer could have a slight negative impact on baseflow in the downstream reaches of streams in these areas. However, many of the streams are dry most all the time; thus, no measurable impact on wildlife along streams is expected.

Although this strategy is expected for groundwater quality that meets standards of use with minimal treatment required, the desalination of slightly saline groundwater produces a concentrate of salts in water that requires disposal. Depending upon location, environmental concerns can be addressed by discharging to saline aquifer by deep well injection, discharging to a salt-water body, or blending with wastewater.

Habitat studies and surveys for protected species may need to be conducted at the proposed well field sites and along any pipeline routes. When potential protected species habitat or other significant resources cannot be avoided, additional studies would have to be conducted to evaluate habitat use or eligibility for inclusion in the National Register for Historic Places, respectively. Wetland impacts, primary pipeline stream crossings, can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetlands may be required where impacts are unavoidable.

5D.8.1.4 Engineering and Costing

Cost estimates for new wells were prepared according to the assumptions presented in the previous section. The capital cost, project cost, annual cost, yield, and unit cost (in $/ac-ft and $/1,000 gallons) for water obtained under this strategy are presented in Table 5D.8.3 through Table 5D.8.26 for each entity county.

Table 5D.8.3.
Cost Estimate Summary Water Supply Project Option
September 2018 Prices
Region N Local Gulf Coast Supplies – County Other Bee County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$3,368,000
Water Treatment Plant (3 MGD)	$195,000
Total Cost of Facilities	**$3,563,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,247,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$133,000
Total Cost of Project	**$4,943,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$348,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$34,000
Water Treatment Plant	$117,000
Pumping Energy Costs (649794 kW-hr @ 0.08 $/kW-hr)	$52,000
Total Annual Cost	**$551,000**
Available Project Yield (acft/yr)	1,682
Annual Cost of Water ($ per acft)	$328
Annual Cost of Water After Debt Service ($ per acft)	$121
Annual Cost of Water ($ per 1,000 gallons)	$1.01
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.37

Table 5D.8.4. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – El Oso WSC

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$278,000
Water Treatment Plant (0.2 MGD)	$27,000
Total Cost of Facilities	**$305,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$107,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$12,000
Total Cost of Project	**$424,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$30,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Water Treatment Plant	$16,000
Pumping Energy Costs (36074 kW-hr @ 0.08 $/kW-hr)	$3,000
Total Annual Cost	**$52,000**
Available Project Yield (acft/yr)	94
Annual Cost of Water ($ per acft)	$553
Annual Cost of Water After Debt Service ($ per acft)	$234
Annual Cost of Water ($ per 1,000 gallons)	$1.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.72

Table 5D.8.5. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Bee County - Irrigation

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$840,000
Total Cost of Facilities	**$840,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$294,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$32,000
Total Cost of Project	**$1,166,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$82,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Pumping Energy Costs (88706 kW-hr @ 0.08 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
Total Annual Cost	**$97,000**
Available Project Yield (acft/yr)	352
Annual Cost of Water ($ per acft)	$276
Annual Cost of Water After Debt Service ($ per acft)	$43
Annual Cost of Water ($ per 1,000 gallons)	$0.85
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.13

Table 5D.8.6.
Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Bee County - Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$448,000
Total Cost of Facilities	**$448,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$157,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$17,000
Total Cost of Project	**$622,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$44,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Pumping Energy Costs (39565 kW-hr @ 0.08 $/kW-hr)	$3,000
Total Annual Cost	**$51,000**
Available Project Yield (acft/yr)	197
Annual Cost of Water ($ per acft)	$259
Annual Cost of Water After Debt Service ($ per acft)	$36
Annual Cost of Water ($ per 1,000 gallons)	$0.79
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.11

Table 5D.8.7. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – TDCJ Chase Field

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$464,000
Water Treatment Plant (0.4 MGD)	$43,000
Total Cost of Facilities	**$507,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$177,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$19,000
Total Cost of Project	**$703,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$49,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Water Treatment Plant	$26,000
Pumping Energy Costs (48160 kW-hr @ 0.08 $/kW-hr)	$4,000
Total Annual Cost	**$84,000**
Available Project Yield (acft/yr)	208
Annual Cost of Water ($ per acft)	$404
Annual Cost of Water After Debt Service ($ per acft)	$168
Annual Cost of Water ($ per 1,000 gallons)	$1.24
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.52

Table 5D.8.8.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies – County Other- Brooks County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$810,000
Water Treatment Plant (0.6 MGD)	$60,000
Total Cost of Facilities	**$870,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$304,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$33,000
Total Cost of Project	**$1,207,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$85,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Water Treatment Plant	$36,000
Pumping Energy Costs (52572 kW-hr @ 0.08 $/kW-hr)	$4,000
Total Annual Cost	**$133,000**
Available Project Yield (acft/yr)	309
Annual Cost of Water ($ per acft)	$430
Annual Cost of Water After Debt Service ($ per acft)	$155
Annual Cost of Water ($ per 1,000 gallons)	$1.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.48

Table 5D.8.9. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Brooks County Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$443,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$155,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$17,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$43,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Pumping Energy Costs (69449 kW-hr @ 0.08 $/kW-hr)	$6,000
Available Project Yield (acft/yr)	182
Annual Cost of Water ($ per acft)	$291
Annual Cost of Water After Debt Service ($ per acft)	$55
Annual Cost of Water ($ per 1,000 gallons)	$0.89
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.17

Table 5D.8.10. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies –County Other- Duval County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,437,000
Water Treatment Plant (0.9 MGD)	$83,000
Total Cost of Facilities	**$1,520,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$532,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$57,000
Total Cost of Project	**$2,109,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$148,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$14,000
Water Treatment Plant	$50,000
Pumping Energy Costs (194062 kW-hr @ 0.08 $/kW-hr)	$16,000
Total Annual Cost	**$228,000**
Available Project Yield (acft/yr)	516
Annual Cost of Water ($ per acft)	$442
Annual Cost of Water After Debt Service ($ per acft)	$155
Annual Cost of Water ($ per 1,000 gallons)	$1.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.48

Table 5D.8.11. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Duval County Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$2,267,000
Total Cost of Facilities	**$2,267,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$793,000
Environmental & Archaeology Studies and Mitigation	$46,000
Land Acquisition and Surveying (6 acres)	$35,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$87,000
Total Cost of Project	**$3,228,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$227,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$23,000
Pumping Energy Costs (302590 kW-hr @ 0.08 $/kW-hr)	$24,000
Total Annual Cost	**$274,000**
Available Project Yield (acft/yr)	768
Annual Cost of Water ($ per acft)	$357
Annual Cost of Water After Debt Service ($ per acft)	$61
Annual Cost of Water ($ per 1,000 gallons)	$1.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.19

Table 5D.8.12.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies –San Diego MUD 1

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,268,000
Water Treatment Plant (0.7 MGD)	$70,000
Total Cost of Facilities	**$1,338,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$468,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$50,000
Total Cost of Project	**$1,856,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$131,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Water Treatment Plant	$42,000
Pumping Energy Costs (37874 kW-hr @ 0.08 $/kW-hr)	$3,000
Total Annual Cost	**$189,000**
Available Project Yield (acft/yr)	417
Annual Cost of Water ($ per acft)	$453
Annual Cost of Water After Debt Service ($ per acft)	$139
Annual Cost of Water ($ per 1,000 gallons)	$1.39
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.43

Table 5D.8.13. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies –County Other- Jim Wells County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$7,431,000
Water Treatment Plant (4.7 MGD)	$285,000
Total Cost of Facilities	**$7,716,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,701,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$287,000
Total Cost of Project	**$10,704,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$753,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$74,000
Water Treatment Plant	$171,000
Pumping Energy Costs (515267 kW-hr @ 0.08 $/kW-hr)	$41,000
Total Annual Cost	**$1,039,000**
Available Project Yield (acft/yr)	2,650
Annual Cost of Water ($ per acft)	$392
Annual Cost of Water After Debt Service ($ per acft)	$108
Annual Cost of Water ($ per 1,000 gallons)	$1.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.33

Table 5D.8.14.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies – Jim Wells County - Irrigation

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$542,000
Total Cost of Facilities	**$542,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$190,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$21,000
Total Cost of Project	**$753,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$53,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Pumping Energy Costs (39190 kW-hr @ 0.08 $/kW-hr)	$3,000
Total Annual Cost	**$61,000**
Available Project Yield (acft/yr)	333
Annual Cost of Water ($ per acft)	$183
Annual Cost of Water After Debt Service ($ per acft)	$24
Annual Cost of Water ($ per 1,000 gallons)	$0.56
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.07

Table5D. 8.15.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies – Jim Wells County – Manufacturing

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$93,000
Total Cost of Facilities	**$93,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$32,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$4,000
Total Cost of Project	**$129,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$9,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Pumping Energy Costs (6795 kW-hr @ 0.08 $/kW-hr)	$1,000
Total Annual Cost	**$11,000**
Available Project Yield (acft/yr)	16
Annual Cost of Water ($ per acft)	$688
Annual Cost of Water After Debt Service ($ per acft)	$125
Annual Cost of Water ($ per 1,000 gallons)	$2.11
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.38

Table 5D.8.16. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Jim Wells County – Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$145,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$51,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$14,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Pumping Energy Costs (23358 kW-hr @ 0.08 $/kW-hr)	$2,000
Available Project Yield (acft/yr)	55
Annual Cost of Water ($ per acft)	$309
Annual Cost of Water After Debt Service ($ per acft)	$55
Annual Cost of Water ($ per 1,000 gallons)	$0.95
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.17

Table 5D.8.17. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Kenedy County - Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$338,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$118,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$13,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$33,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Pumping Energy Costs (6608 kW-hr @ 0.08 $/kW-hr)	$1,000
Available Project Yield (acft/yr)	63
Annual Cost of Water ($ per acft)	$587
Annual Cost of Water After Debt Service ($ per acft)	$63
Annual Cost of Water ($ per 1,000 gallons)	$1.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.19

Table 5D.8.18. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Kleberg County – Manufacturing

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$614,000
Total Cost of Facilities	**$614,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$215,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$23,000
Total Cost of Project	**$852,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$60,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Pumping Energy Costs (25909 kW-hr @ 0.08 $/kW-hr)	$2,000
Total Annual Cost	**$68,000**
Available Project Yield (acft/yr)	247
Annual Cost of Water ($ per acft)	$275
Annual Cost of Water After Debt Service ($ per acft)	$32
Annual Cost of Water ($ per 1,000 gallons)	$0.84
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.10

Table 5D.8.19. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Kleberg County - Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$459,000
Total Cost of Facilities	**$459,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$161,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$18,000
Total Cost of Project	**$638,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$45,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Pumping Energy Costs (14895 kW-hr @ 0.08 $/kW-hr)	$1,000
Total Annual Cost	**$51,000**
Available Project Yield (acft/yr)	142
Annual Cost of Water ($ per acft)	$359
Annual Cost of Water After Debt Service ($ per acft)	$42
Annual Cost of Water ($ per 1,000 gallons)	$1.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.13

Table 5D.8.20.
Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Live Oak County - Irrigation

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$661,000
Total Cost of Facilities	**$661,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$231,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$25,000
Total Cost of Project	**$917,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$65,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Pumping Energy Costs (56014 kW-hr @ 0.08 $/kW-hr)	$4,000
Total Annual Cost	**$76,000**
Available Project Yield (acft/yr)	534
Annual Cost of Water ($ per acft)	$142
Annual Cost of Water After Debt Service ($ per acft)	$21
Annual Cost of Water ($ per 1,000 gallons)	$0.44
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.06

Table 5D.8.21.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies – Live Oak County - Manufacturing

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$135,000
Total Cost of Facilities	**$135,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$47,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,000
Total Cost of Project	**$188,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$13,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Pumping Energy Costs (2937 kW-hr @ 0.08 $/kW-hr)	$235
Total Annual Cost	**$14,000**
Available Project Yield (acft/yr)	28
Annual Cost of Water ($ per acft)	$500
Annual Cost of Water After Debt Service ($ per acft)	$36
Annual Cost of Water ($ per 1,000 gallons)	$1.53
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.11

Table 5D.8.22.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies –County Other- Nueces County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$3,080,000
Water Treatment Plant (2.6 MGD)	$174,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,139,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$121,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$318,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$31,000
Water Treatment Plant	$104,000
Pumping Energy Costs (110140 kW-hr @ 0.08 $/kW-hr)	$9,000
Available Project Yield (acft/yr)	1,435
Annual Cost of Water ($ per acft)	$322
Annual Cost of Water After Debt Service ($ per acft)	$100
Annual Cost of Water ($ per 1,000 gallons)	$0.99
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.31

Table 5D.8.23. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Nueces-County Irrigation

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$230,000
Total Cost of Facilities	**$230,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$80,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$9,000
Total Cost of Project	**$319,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$22,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Pumping Energy Costs (3784 kW-hr @ 0.08 $/kW-hr)	$303
Total Annual Cost	**$24,000**
Available Project Yield (acft/yr)	51
Annual Cost of Water ($ per acft)	$471
Annual Cost of Water After Debt Service ($ per acft)	$39
Annual Cost of Water ($ per 1,000 gallons)	$1.44
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.12

Table 5D.8.24.
Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – Nueces-County Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$1,586,000
Total Cost of Facilities	**$1,586,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$555,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$59,000
Total Cost of Project	**$2,200,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$155,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Pumping Energy Costs (3784 kW-hr @ 0.08 $/kW-hr)	$7,000
Total Annual Cost	**$178,000**
Available Project Yield (acft/yr)	1,127
Annual Cost of Water ($ per acft)	$158
Annual Cost of Water After Debt Service ($ per acft)	$20
Annual Cost of Water ($ per 1,000 gallons)	$0.48
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.06

Table 5D.8.25. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Region N Local Gulf Coast Supplies – San Patricio-County Irrigation

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$302,000
Total Cost of Facilities	**$302,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$106,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$12,000
Total Cost of Project	**$420,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$30,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Pumping Energy Costs (2098 kW-hr @ 0.08 $/kW-hr)	$168
Total Annual Cost	**$33,000**
Available Project Yield (acft/yr)	204
Annual Cost of Water ($ per acft)	$162
Annual Cost of Water After Debt Service ($ per acft)	$15
Annual Cost of Water ($ per 1,000 gallons)	$0.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.05

Table 5D.8.26.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Region N Local Gulf Coast Supplies – San Patricio-County Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$822,000
Total Cost of Facilities	**$822,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$288,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$31,000
Total Cost of Project	**$1,141,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$80,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Pumping Energy Costs (41748 kW-hr @ 0.08 $/kW-hr)	$3,000
Total Annual Cost	**$91,000**
Available Project Yield (acft/yr)	398
Annual Cost of Water ($ per acft)	$229
Annual Cost of Water After Debt Service ($ per acft)	$28
Annual Cost of Water ($ per 1,000 gallons)	$0.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.08

5D.8.1.5 Implementation Issues

The development of additional wells and the installation and operation of brackish water treatment plant, if required, may have to address the following issues.

- Disposal of salt concentrate from water treatment plant;
- Impact on:
    - Endangered and other wildlife species,
    - Water levels in the aquifer,
    - Baseflow in streams, and
    - Wetlands;
- Capital and operation and maintenance costs;
- Skilled operators of desalination water treatment plants;
- Competition with others for groundwater in the area;
- Detailed feasibility evaluation including test drilling and aquifer water quality testing; and

Local groundwater districts or Groundwater Management Areas should be consulted for well permit requirements and in accordance with MAG conditions. The potential for regulations by groundwater conservation districts in the future is likely based on future MAGs identified by local districts or Groundwater Management Area, including the renewal of pumping permit at periodic intervals in counties where districts have been organized.

5D.8.1.6 Evaluation Summary

An evaluation summary of this regional water management option is provided in Table 5D.8.27.

Table 5D.8.27.
Evaluation Summary for Drilling Wells to Provide Additional Groundwater Supply for Municipal Rural Water Systems, Irrigation, Manufacturing, and Mining Water Users

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: Varies from 16 to 2, 650 ac-ft.
2. Reliability	2. Good reliability, if adequate water quality.
3. Cost of treated water	3. Cost: $142 to $688 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Some. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
3. Wildlife habitat	3. Negligible impacts.
4. Wetlands	4. Negligible impacts.
5. Threatened and endangered species	5. Negligible impacts.
6. Cultural resources	6. Cultural resources will need to be surveyed and avoided.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Negligible impacts. a. Low to moderate impact. b. Low to moderate impact. c. No impact. d. Low to moderate impact. e. Low to moderate impact. f. Low to moderate impact. g-h. Low to moderate impact associated with mining. i. Boron may be a potential water quality concern.
c. Impacts to agricultural resources and State water resources	• Low impacts. No negative impacts on water resources other than slight lowering of Gulf Coast Aquifer levels.
d. Threats to agriculture and natural resources in region	• May slightly increase pumping costs for agricultural users in the area due to localized drawdowns
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities with local resources
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

5D.8.2 Evangeline/Laguna LP Raw Groundwater Project

5D.8.2.1 Description of Strategy

The Evangeline/Laguna LP Groundwater Project includes groundwater production of up to 25.4 MGD (28,486 acft/yr) from 23,000+ acres located in San Patricio County for conveyance and delivery to the City of Corpus Christi and/or future industries in San Patricio County. Figure 5D.8.1 shows the approximate location of the project site. Since the 2016 Plan, project developers have moved this project towards implementation by securing permits from the San Patricio County Groundwater Conservation District (SPCGCD), drilling and collecting data from a test well, and performing a corrosion analysis, but no blending analysis has been conducted yet. The test well water quality results were all within TCEQ drinking water standards. TDS and chloride levels measured at the test well were 792 mg/L and 269 mg/L, respectively. The SPCGCD production permit granted to Evangeline/Laguna LP is for up to 25.4 MGD (28,486 acft/yr), the current modeled available groundwater (MAG) for regional planning purposes limits groundwater production in San Patricio County to 24,873 acft/yr in Year 2020. However, in Year 2050, the full groundwater production equal to the 25.4 MGD permit issued by the SPCGCD is available under regional planning guidelines.

This project has been evaluated in two ways for the 2021 Region N Plan: (a) as a raw, groundwater supply with minimal treatment and (b) with groundwater desalination to reduce TDS and chlorides to around 200 mg/L for high water quality use (Chapter 5D.9). **The strategy presented here is for the raw, groundwater supply with minimal treatment options based on the water quality results provided by Evangeline/Laguna LP that shows water quality results within TCEQ drinking water standards**.

This project will be phased based on MAG limitations, with full well field build-out after 2050 as described above. The first phase is a well field with 13 wells (production constrained by MAG), but at full project production, the wellfield consists of 18 wells including contingency. The wells will be around 1,000 ft and have an estimated pumping rate of 1,200 gpm. The current raw groundwater quality is around 800 mg/L TDS, and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides. Based on test well data water quality meets drinking water standards and could be delivered to a customer untreated or with minimal chlorine treatment.

Three delivery options were evaluated as part of this water management strategy and the costs are provided in the Engineering and Costing Section.

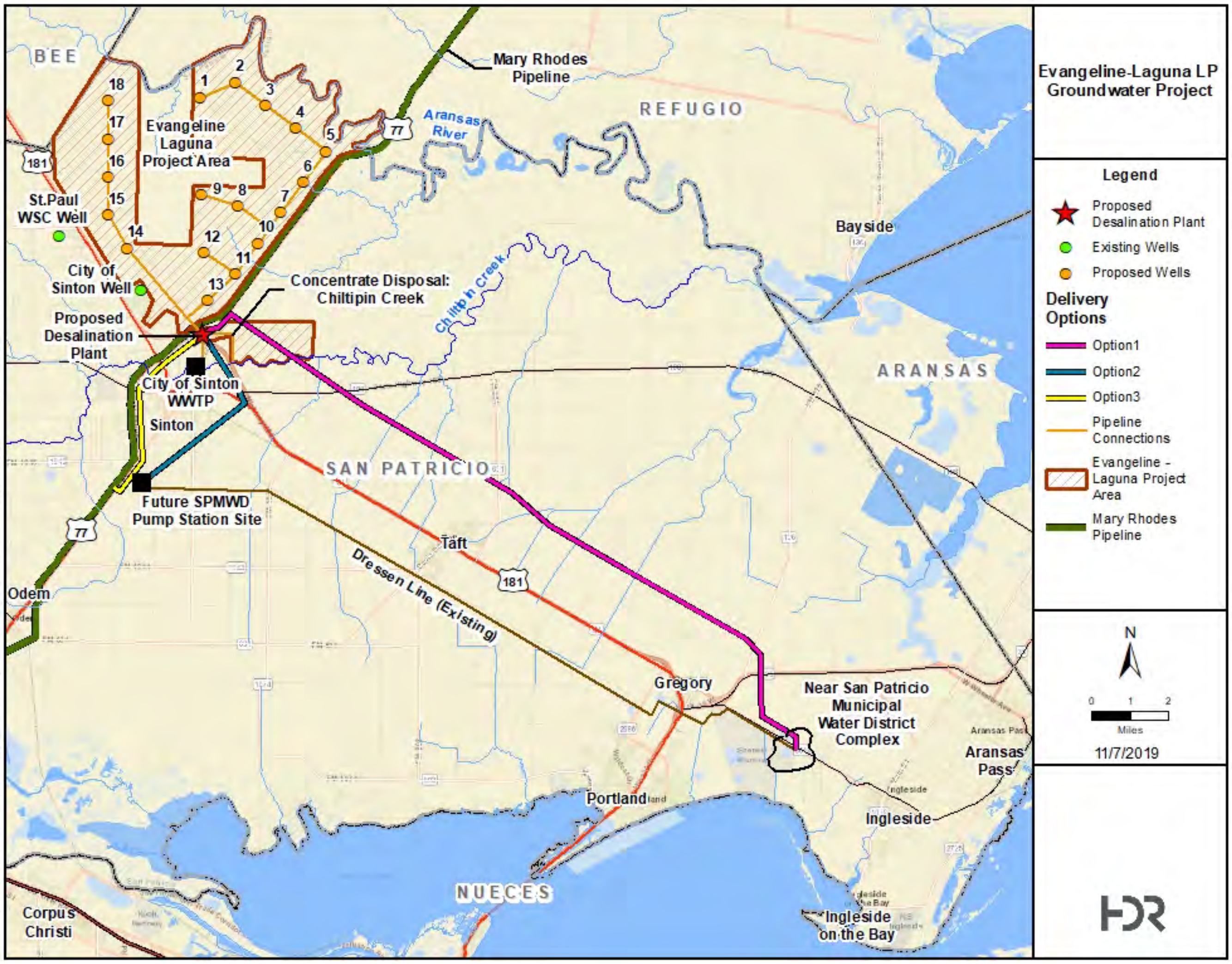

Figure 5D.8.1.
Location of Conceptual Layout of Evangeline/Laguna LP Groundwater Project

5D.8.2.2 Available Yield

In the Coastal Bend region, the Gulf Coast Aquifer System is the primary source of substantial groundwater supplies. The most productive water-bearing zone is the Goliad Sand, which is also known as the Evangeline Aquifer. The outcrop of the Goliad Sand is about 50 to 75 miles inland. The formation dips toward the coast at about 20 feet per mile. Near the coast, the shallower Chicot Aquifer provides some groundwater supplies. West of the outcrop of the Goliad Sands, the deeper Jasper Aquifer can supply a moderate amount of groundwater in some areas.

The SPCGCD production permit granted to Evangeline/Laguna LP is for up to 25.4 MGD (28,486 acft/yr), the current modeled available groundwater (MAG) for regional planning purposes limits groundwater production in San Patricio County to 24,873 acft/yr in Year 2020. However, in Year 2050, the full groundwater production equal to the 25.4 MGD permit issued by the SPCGCD is available under regional planning guidelines.

5D.8.2.3 Environmental Issues

The primary environmental issues related to the development of raw groundwater from the Evangeline Aquifer in San Patricio County are the development of the well fields and associated pipelines, and integration into the pipeline system for conveyance and delivery.

The project is located in the Gulf Coastal Plains of Texas Physiographic Province, specifically in the subprovince of the Coastal Prairies. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

Environmental Considerations Associated with Evangeline-Laguna LP Groundwater Project

The Evangeline-Laguna LP Groundwater project includes a well field of 18 water wells located in San Patricio County near its border with Bee County. For this strategy, water would be minimally treated and delivered to the City of Corpus Christi and/or to San Patricio Municipal Water District for future industries in San Patricio County.

Three delivery pipeline options are proposed. The proposed transmission pipelines cross areas which are primarily used for pasture and crops. Vegetation types found along the pipeline route also include areas of Mesquite-Live Oak-Bluewood Parks. Planning of the pipeline route should include avoidance of impacts to wetland areas where possible. Although the construction of portions of the treated water pipeline may include the clearing and removal of woody vegetation, destruction of potential habitat can generally be avoided by diverting the corridor through previously disturbed areas.

The well field area is primarily located within an area used for crops; however, it also contains smaller portions of Mesquite-Live Oak-Bluewood Parks vegetation areas. Mesquite-Live Oak-Bluewood Parks areas commonly contain plants such as huisache, grajeno, lotebush, pricklypear, agarita, purple threeawn, and Mexican persimmon. Distribution of this vegetation type is found primarily within the South Texas Plains. Site selection for the wells should include the avoidance of impacts to wetland areas.

Appropriate pipeline route selection, construction methods and right-of-way selection should avoid or minimize anticipated impacts to potential wetland areas or other waters of the U.S. along the three treated water pipeline options.

Area Vegetation and Wildlife Habitat

The groundwater project area is located within the Gulf Prairies and Marshes Vegetational Area. Gulf Prairies have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However tree species such as honey mesquite, and acacia, along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak

(*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), black-brush (*A. rigidula*), and a dwarf shrub; bushy sea-ox-eye (*Borrichia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiangrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Prickleypear (*Opunita* sp.) are common within this area along with forbs including asters (*Aster* sp.), poppy mallows (*Callirhoe* sp.), bluebonnets (*Lupinus* sp.), and evening primroses (*Oenothera* sp.). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus* sp.), bulrushes (*Scirpus* sp.), rushes (*Juncus* sp.), and grasses. Aquatic forbs found in these areas generally include pepperweeds (*Lepidium* sp.), smartweeds (*Polygonum* sp.), cattails (*Typha domingensis*) and spiderworts (*Tradescantia* sp.) among others. Game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

Threatened and Endangered Species (ES)

The Federal Endangered Species Act of 1973, as amended, prohibits the "take" of any threatened or endangered species. The term "take" under the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." The term "harm" was further defined to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shore-birds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the pipeline area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Pipeline construction activities could disturb migratory bird habitats and/or species' activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project's activities on threatened and endangered species, as well as bald eagles. Species' locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service and TPWD recommendations.

In San Patricio County there may occur 40 state-listed endangered or threatened species and 19 federally-listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat and potential occurrence in the four county areas is provided in Table 5D.8.28.

Table 5D.8.28. Federal- and State-Listed Threatened, Endangered, and Species of Concern Listed for San Patricio County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	*Notophthalmus meridionalis*	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	*Hypopachus variolosus*	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	*Siren sp. 1*	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Strecker's chorus frog	*Pseudacris streckeri*	Wooded floodplains and flats, prairies, cultivated fields and marshes.	Resident	--	--
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes, nests in tall trees or on cliffs near water.	Resident	--	T
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	PT	--
Botteri's sparrow	*Peucaea botterii*	Habitat description is not available at this time.	Resident	--	T
Eskimo Curlew	*Numenius borealis*	Nonbreeding in grasslands, pastures and plowed fields	Historic	LE	E
Franklin's gull	*Leucophaeus pipixcan*	Habitat description is not available at this time.	Migrant	__	__
Mountain plover	*Charadrius montanus*	Breeding, nesting on shortgrass prairie	Resident	__	__
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus	Migrant	LE	E
Piping plover	*Charadrius melodus*	Beaches and flats of coastal Texas	Migrant	LT	T
Red knot	*Calidris canutus rufa*	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	LT	--
Swallow-tailed kite	*Elanoides forficatus*	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	__	T
Texas Botteri's Sparrow	*Aimophila botterii texana*	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses	Resident	__	T
Tropical kingbird	*Tyrannus melancholicus*	Habitat description is not available at this time	Resident	--	--
Tropical parula	*Setophaga pitiayumi*	Semi-tropical evergreen woodland along rivers and resacas	Resident	--	T
Western burrowing owl	*Athene cunicularia hypugaea*	Open grasslands, especially prairie	Resident	__	__

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes	Resident	__	T
White-tailed hawk	*Buteo albicaudatus*	Coastal prairies, savannahs and marshes in Gulf Coastal Plain	Nesting/Migrant	__	T
Whooping crane	*Grus Americana*	Winters in coastal marshes	Migrant	LE	E
Wood stork	*Mycteria Americana*	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas	Migrant	__	T
Opossum pipefish	*Microphis brachyurus*	Brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth.	Aquatic Resident	--	T
Snook	*Centropomus undecimalis*	Habitat description is not available at this time	Aquatic Resident	--	--
Southern flounder	*Paralichthys lethostigma*	Habitat description is not available at this time	Aquatic Resident	--	--
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time	Resident	--	--
Manfreda giant-skipper	*Stallingsia maculosus*	Most skippers are small and stout-bodied; name derives from fast, erratic flight	Resident	__	__
No accepted common name	*Disonycha stenosticha*	Habitat description is not available at this time	Resident	__	__
No accepted common name	*Dacoderus steineri*	Habitat description is not available at this time	Resident	__	__
No accepted common name	*Cryptocephalus downiei*	Habitat description is not available at this time	Resident	__	__
No accepted common name	*Ormiscus albofasciatus*	Habitat description is not available at this time	Resident	__	__
No accepted common name	*Ceophengus pallidus*	Habitat description is not available at this time	Resident	__	__
American badger	*Taxidea taxus*	Habitat description is not available at this time	Resident	__	__
Big free-tailed bat	*Nyctinomops macrotis*	Roosts in crevices and cracks in high canyon walls, but will use buildings as well.	Resident	--	--
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, carports, and under bridges	Resident	--	--
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas.	Resident	--	--
Eastern spotted skunk	*Spilogale putorius*	Catholic, open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	Resident	--	--
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodland in Trans-Pecos, forest and woods in east central Texas.	Resident	--	--
Humpback whale	*Megaptera novaeangliae*	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	LE	E

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Long-tailed weasel	*Mustela frenata*	Brushlands, fence rows, upland woods and bottomland hardwoods, forest edges, and rocky desert scrub	Resident	--	--
Maritime pocket gopher	*Geomys personatus maritimus*	Fossorial in deep sandy soils.	Resident	--	--
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	Resident	--	--
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	Resident	--	--
Ocelot	*Leopardus pardalis*	Dense chaparral thickets; mesquite-thorn shrub and live oak stands	Resident	LE	E
Plains spotted skunk	*Spilogale putorius interrupta*	Open fields, and prairies	Resident	—	—
Southern yellow bat	*Lasiurus ega*	Associated with trees, such as palm trees	Resident	—	T
Swamp rabbit	*Sylvilagus aquaticus*	Habitat description is not available at this time.	Resident	--	--
Tricolored bat	*Perimyotis subflavus*	Forest, woodland, and riparian areas are important. Caves are very important	Resident	--	--
Western hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts to 7,200 feet.	Resident	--	--
White-nosed coati	*Nasua narica*	Woodlands, riparian corridors and canyons	Transient	—	T
Golden Orb	*Quadrula aurea*	Sand/ gravel areas in river basins	Resident	C	T
No accepted common name	*Praticolella candida*	Habitat description is not available at this time	Resident	--	--
American alligator	*Alligator mississippiensis*	Coastal marshes, inland natural rivers and marshes, manmade impoundments	Resident	--	--
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	Gulf and bay system, warm shallow waters especially in rocky marine environments	Aquatic Resident	LE	E
Common garter snake	*Thamnophis sirtalis*	Irrigation canals and riparian-corridor farmlands in west. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water, coastal salt marshes.	Resident	--	--
Eastern box turtle	*Terrapene carolina*	Forests, fields, forest-brush and forest-field ecotones.	Resident	--	--
Green sea turtle	*Chelonia mydas*	Gulf and bay systems; shallow water seagrass beds	Aquatic Resident	LT	T
Keeled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates	Resident	—	—
Loggerhead sea turtle	*Caretta caretta*	Gulf and bay systems for juveniles, adults prefer open waters	Aquatic Resident	LT	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Resident	--	--
Northern scarlet snake	*Cemophora coccinea coperi*	Along Gulf Coast, known from mixed hardwood scrub on sandy soils.	Resident	--	T
Slender glass lizard	*Ophisaurus attenuatus*	Open grassland, prairie, woodland edge, open woodland, oak savannas, longleaf pine flatwoods, scrubby areas, fallow fields, and areas near streams and ponds.	Resident	--	--
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	Habitat description is not available at this time.	Resident	--	--
Spot-tailed earless lizard	*Holbrookia lacerate*	Open prairie-brushland	Resident	__	__
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	Coastal marshes and tidal flats	Resident	__	__
Texas horned lizard	*Phrynosoma cornutum*	Varied; sparsely vegetated uplands, grass, cactus, brush	Resident	__	T
Texas Indigo snake	*Drymarchon melanurus erebennus*	Thornbrush-chapparal woodland of south Texas, in particular dense riparian corridors. Can do well in suburban and irrigated croplands.	Resident	--	T
Texas scarlet snake	*Cemophora coccinea lineri*	Mixed hardwood scrub on sandy soils	Resident	__	T
Texas tortoise	*Gopherus berlandieri*	Open bush with grass understory; open grass and bare ground avoided	Resident	__	T
Timber/Canebrake rattlesnake	*Crotalus horridus*	Floodplains, riparian zones with dense ground cover	Resident	__	T
Western box turtle	*Terrapene ornate*	Prairie grassland, pasture, fields, sandhills, and open woodland.	Resident	--	--
Arrowleaf milkvine	*Matelea sagittifolia*	Most consistently encountered in thronscrub in south Texas.	Resident	--	--
Billie's bitterweed	*Tetraneuris turneri*	Grasslands on shallow sandy soils and caliche outcrops.	Resident	--	--
Coastal gay-feather	*Liatris bracteata*	Endemic to black clay soils of prairie	Resident	__	__
Crestless onion	*Allium canadense var. ecristatum*	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area (Carr 2015)	Resident	--	--
Croft's bluet	*Houstonia croftiae*	Occurs in sparsely vegetated areas in grasslands or among shrubs (Carr 2015)	Resident	--	--
Drummond's rushpea	*Caesalpinia drummondii*	Open areas on sandy clay.	Resident	--	--
Elmendorf's onion	*Allium elmendorfii*	Endemic to grassland openings in woodlands	Resident	__	__
Greenman's bluet	*Houstonia parviflora*	Habitat description is not available at this time.	Resident	--	--

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Indianola beakrush	*Rhynchospora indianolensis*	Locally abundant in cattle pastures in some areas (at least during wet years).	Resident	--	--
Jone's rainlilly	*Cooperia jonesii*	Habitat description is not available at this time.	Resident	--	--
Large selenia	*Selenia grandis*	Occurs in seasonally wet clayey soils in open areas.	Resident	--	--
Lila de los Llanos	*Echeandia chandleri*	Shrubs or in grassy openings in subtropical thorn shrublands along Gulf Coast	Resident	—	—
Low spurge	*Euphorbia peplidion*	Occurs in a variety of vernally-moist situations in a number of natural regions.	Resident	--	--
Net-leaf bundleflower	*Desmanthus reticulatus*	Mostly on clay prairies of the coastal plain of central and south Texas.	Resident	--	--
Plains gumweed	*Grindelia oolepis*	Coastal prairies on heavy clay soils	Resident	—	—
Refugio rainlily	*Zephyranthes refugiensis*	Occurs on deep heavy black clay soils or sandy loams in swales or drainages on herbacrous grasslands or shrublands on level to rolling landscapes underlain by the Lissie Formation.	Resident	--	--
Sand Brazos mint	*Brazoria arenaria*	Sandy areas in South Texas.	Resident	--	--
Seaside beebalm	*Monarda maritima*	Occurs in grasslands and pastures on sandy soil near the coast.	Resident	--	--
South Texas false cudweed	*Pseudognaphalium austrotexanum*	Habitat description is not available at this time.	Resident	--	--
South Texas spikesedge	*Eleocharis austrotexana*	Occurring in miscellaneous wetlands at scattered locations on the coastal plain.	Resident	--	--
South Texas yellow clammyweed	*Polanisia erosa ssp. Breviglandulosa*	Habitat description is not available at this time.	Resident	--	--
Texsa peachbush	*Prunus texana*	Occurs at scattered sites in various well drained sandy situations.	Resident	--	--
Texas stonecrop	*Lenophyllum texanum*	Found in shrublands on clay dunes (lomas) at the mouth of the Rio Grande and on calcareous rock outcrops at scattered inland sites.	Resident	--	--
Texas wilkommia	*Wilkommia texana var. texana*	Mostly in sparsely vegetated patches within taller prairies on alkaline or saline soils on the Coastal Plain (Carr 2015)	Resident	--	--
Texas windmill-grass	*Chloris texensis*	Texas endemic; sandy to sandy loam soils in bare areas in coastal prairie grassland remnants	Resident	—	—
Tharp's dropseed	*Sporobolus tharpii*	Occurs on barrier islands, shores of lagoons and bays protected by the barrier islands, and on shores of a few near-coastal ponds.	Resident	--	--

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Three-flower broomweed	*Thurovia triflora*	Endemic, remnant grasslands and tidal flats	Resident	—	—
Tree dodder	*Cuscuta exaltata*	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmus*, and *Diospyros* species as well as *Acacia berlandieri* and other woody plants.	Resident	--	--
Velvet spurge	*Euphorbia innocua*	Open or brushy areas on coastal sands and the south Texas Sand Sheet.	Resident	--	--
Welder machaeranthera	*Psilactia heterocarpa*	Grasslands, varying from midgrass coastal prairies, and open mesquite-huisache woodlands.	Resident	--	--
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	Most records from Texas are historical.	Historic Resident	--	--

Source: TPWD, Annotated County List of Rare Species, San Patricio County, July 17, 2019.

PT Proposed Threatened
LT Federally listed threatened
E State Endangered
LE Federally listed endangered
-- Not Listed (Species of Concern)
T State Threatened

Inclusion in Table 5D.8.28 does not imply that a species will occur within the project area, but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance is necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed project occurs primarily in areas which have been previously developed and used for farming and pasture for a long period of time. Disturbance within these areas due to construction of the pipeline routes and well field is anticipated to have minimal effect on the existing environment. Although suitable habitat for some listed species may exist within the project areas, no impact is anticipated due to the abundance of similar habitat near the project area and the ability of most species to relocate to those areas if necessary. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetland impacts could occur along the pipeline and well field areas located near rivers, streams, or marshy areas. The wells, collection system within the well field, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable and a permit from the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

Cultural Resources

Impacts to National Register-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the well fields and pipeline routes.

A cultural resource survey of the well field and pipeline routes for each of the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

The pumping of groundwater from the Evangeline Aquifer could cause a slight reduction on baseflow in downstream reaches. However, no measurable impact on wildlife along the streams is anticipated from this project. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent.

5D.8.2.4 Engineering and Costing

Based on data collected and provided by Evangeline/Laguna LP, the key features identified and evaluated for planning and costing purposes for 2021 Region N Plan water management strategy are as follows:

- Wells: The well field consists of 13 wells (production constrained by MAG). At full project production, the wellfield consists of 18 wells including contingency. Well depth = 1,000 ft Pumping rate = 1,200 gallons per minute (gpm) each. Wells are phased based on MAG limitations, with full well field build-out after Year 2050 as described above.
- Raw groundwater quality of 800 mg/L TDS is expected, and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides.
- A purchase cost of raw water of $480.60 per ac-ft.
- Facilities are sized to deliver full project amount: 28,486 acft/yr (25 MGD). Yield is limited based on MAG.
- Raw water delivery options:
  - Option 1 - Evangeline/Laguna LP Raw Groundwater Strategy- Region N Plan With MAG Limits (Delivery Option 1, Figure 5D.8.1)
  - Option 2 - Evangeline/Laguna LP Raw Groundwater Strategy - Region N Plan With MAG Limits (Delivery Option 2, Figure 5D.8.1)
  - Option 3 - Evangeline/Laguna LP Raw Groundwater Strategy - Region N Plan With MAG Limits (Delivery Option 3, Figure 5D.8.1)

Overall, the project cost ranges from $74,596,000 to $115,585,000 depending on delivery option. Annual costs range from $18,492,000 to $22,210,000. At a yield of 24,873 ac-ft/yr, the unit cost of water ranges from $743 to $893 per ac-ft. Cost tables are presented in Table 5D.8.29 through Table 5D.8.32. A cost estimate summarizing updated unit cost with full utilization of Delivery Option 1 after 2050 when sufficient MAG is available is shown in Table 5D.8.30.

Table 5D.8.29. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Raw Groundwater Strategy- Region N Plan with MAG Limits (Delivery Option 1)

Item	Estimated Costs for Facilities
Primary Pump Station	$14,127,000
Transmission Pipeline (36 in dia., 20.5 miles)	$28,911,000
Well Fields (18 Wells, *only 12 Operating*, Pumps, and Piping)	$35,051,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,956,000
Water Treatment Plant (0 MGD)	$0
Total Cost of Facilities	**$80,045,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$26,570,000
Environmental & Archaeology Studies and Mitigation	$1,002,000
Land Acquisition and Surveying (~80 acres)	$532,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$7,436,000
Total Cost of Project	**$115,585,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$8,133,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$659,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$353,000
Pumping Energy Costs (13890348 kW-hr @ 0.08 $/kW-hr)	$1,111,000
Purchase of Water (24873 acft/yr @ 480.6 $/acft)	$11,954,000
Total Annual Cost	**$22,210,000**
Available Project Yield (acft/yr)	24,873
Annual Cost of Water ($ per acft)	$893
Annual Cost of Water After Debt Service ($ per acft)	$566
Annual Cost of Water ($ per 1,000 gallons)	$2.74
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.74

Note: One or more cost element has been calculated externally

Table 5D.8.30. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Raw Groundwater Strategy- Up to Permitted Amount after 2050 when MAG is Available (Delivery Option 1)

Item	Estimated Costs for Facilities
Primary Pump Station	$14,127,000
Transmission Pipeline (36 in dia., 20.5 miles)	$28,911,000
Well Fields (18 Wells, Pumps, and Piping)	$35,051,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,956,000
Water Treatment Plant (0 MGD)	$0
Total Cost of Facilities	**$80,045,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$26,570,000
Environmental & Archaeology Studies and Mitigation	$1,002,000
Land Acquisition and Surveying (~80 acres)	$532,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$7,436,000
Total Cost of Project	**$115,585,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$8,133,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$659,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$353,000
Water Treatment Plant	$0
Pumping Energy Costs (20142359 kW-hr @ 0.08 $/kW-hr)	$1,611,000
Purchase of Water (28485 acft/yr @ 480.6 $/acft)	$13,690,000
Total Annual Cost	**$24,446,000**
Available Project Yield (acft/yr)	28,486
Annual Cost of Water ($ per acft)	$858
Annual Cost of Water After Debt Service ($ per acft)	$573
Annual Cost of Water ($ per 1,000 gallons)	$2.63
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.76

Note: One or more cost element has been calculated externally

Table 5D.8.31.
Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Raw Groundwater Strategy - Region N Plan With MAG Limits (Option 2)

Item	Estimated Costs for Facilities
Primary Pump Station	$5,769,000
Transmission Pipeline (36 in dia., 5 miles)	$8,542,000
Well Fields (18 Wells *only 12 Operating*, Pumps, and Piping)	$35,051,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,956,000
Water Treatment Plant (0 MGD)	$0
Total Cost of Facilities	**$51,318,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$17,534,000
Environmental & Archaeology Studies and Mitigation	$622,000
Land Acquisition and Surveying (19 acres)	$323,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$4,799,000
Total Cost of Project	**$74,596,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$5,249,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$455,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$144,000
Pumping Energy Costs (8621955 kW-hr @ 0.08 $/kW-hr)	$690,000
Purchase of Water (24873 acft/yr @ 480.6 $/acft)	$11,954,000
Total Annual Cost	**$18,492,000**
Available Project Yield (acft/yr)	24,873
Annual Cost of Water ($ per acft)	$743
Annual Cost of Water After Debt Service ($ per acft)	$532
Annual Cost of Water ($ per 1,000 gallons)	$2.28
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.63

Note: One or more cost element has been calculated externally

Table 5D.8.32. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Raw Groundwater Strategy - Region N Plan With MAG Limits (Option 3)

Item	Estimated Costs for Facilities
Primary Pump Station	$7,672,000
Transmission Pipeline (36 in dia., 5.6 miles)	$9,053,000
Well Fields (18 Wells *only 12 Operating*, Pumps, and Piping)	$35,051,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,956,000
Water Treatment Plant (0 MGD)	$0
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$18,353,000
Environmental & Archaeology Studies and Mitigation	$629,000
Land Acquisition and Surveying (20 acres)	$327,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$5,022,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$5,493,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$461,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$192,000
Pumping Energy Costs (10149031 kW-hr @ 0.08 $/kW-hr)	$812,000
MRP Energy and Power Capacity Compensation	$207,000
Purchase of Water (24873 acft/yr @ 480.6 $/acft)	$11,954,000
Available Project Yield (acft/yr)	24,873
Annual Cost of Water ($ per acft)	$769
Annual Cost of Water After Debt Service ($ per acft)	$548
Annual Cost of Water ($ per 1,000 gallons)	$2.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.68

Note: One or more cost element has been calculated externally

5D.8.2.5 Implementation Issues

The groundwater supply analyses considered for this water management strategy were based on MAGs adopted by local GCD and GMAs according to TWDB guidance for regional water planning. For future planning efforts, new MAGs provided by GCDs and GMAs located in the Coastal Bend Region need to be considered when determining available groundwater supplies.

Implementation of the Raw Groundwater Supply Project includes the following issues:

- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Purchase of water or lease of property for well field, and coordination with landowners;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- General Land Office Easement for use of State-owned lands, if any;
- Cultural resources investigations in accordance with the Texas Historical Commission and the Texas Antiquities Code;
- Texas Parks and Wildlife Department Sand, Gravel, and Marl permit; and
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

5D.8.2.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.8.33.

Table 5D.8.33.
Evaluation Summary of the Evangeline/Laguna LP Raw Groundwater Project Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield limited to 24,873 acft/yr through 2050 based on MAG.
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate cost; between $743 to $893 per ac-ft for three different delivery options.
b. Environmental factors:	
1. Instream flows	1. Moderate impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife habitat	3. None or low impact
4. Wetlands	4. None or low impact
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a-b,d. Total dissolved solids, chloride, and salinity of water is expected to be within TCEQ drinking water standards. c. None or low impact. e-i. Sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Negligible impacts to agricultural resources. • None or low negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• None or low impacts. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions •
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

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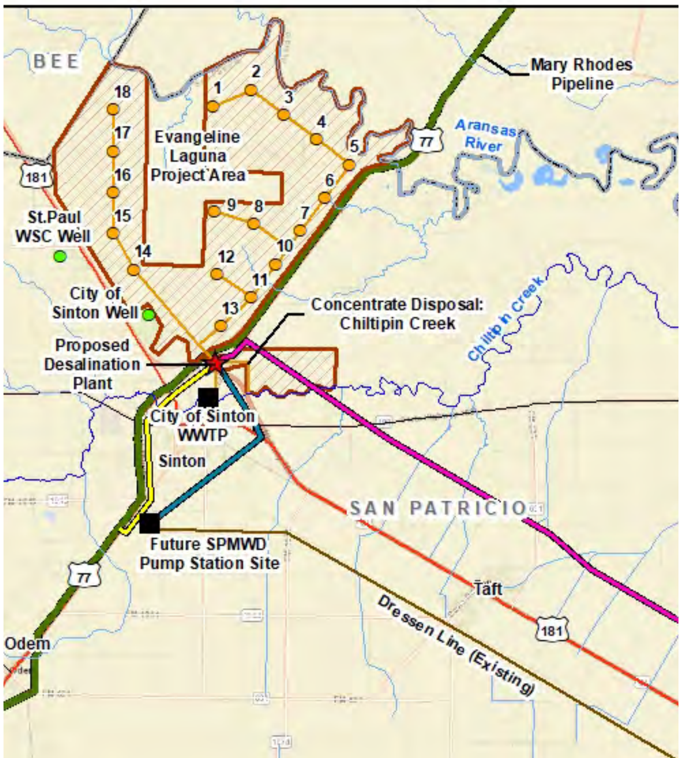

5D.9

Groundwater Desalination (N-9)

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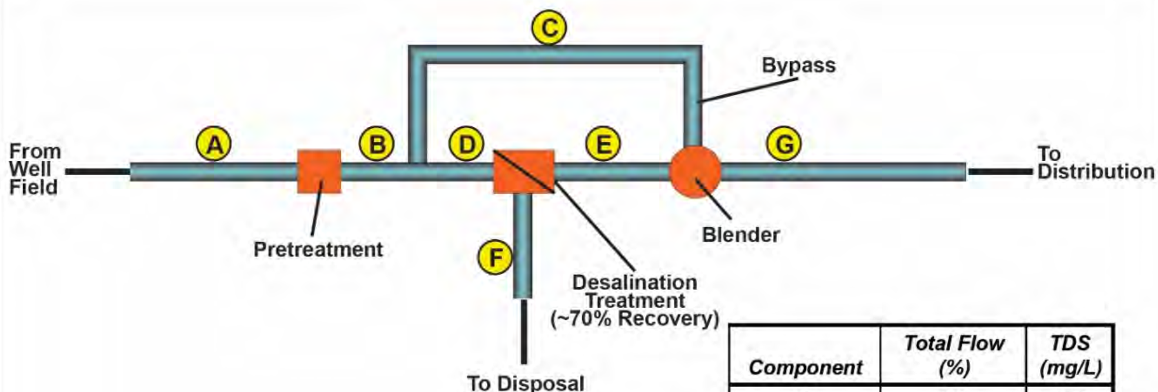
5D.9 Groundwater Desalination

Groundwater desalination is a process whereby pumped groundwater is treated using reverse osmosis, electrodialysis, or similar method to reduce total dissolved solids, salts, and minerals to make suitable for consumption and/or high quality purposes. Brackish groundwater is defined as groundwater with total dissolved solids (TDS) content of between 1,000 and 10,000 parts per million.

Brackish groundwater is an important water supply source in Texas. The state has more than 2.7 billion acre-feet of brackish groundwater in 27 of the 31 major and minor aquifers[1]. Factors that affect the implementation of desalination include local conditions, permitting, treatment, and concentrate disposal. Groundwater supplies desalinated to potable standards in areas near Region N are likely to become more prevalent under the compounding pressures of increasing water demands and climate uncertainty.

Figure 5D.9.1 shows a process diagram for a typical groundwater desalination treatment plant, the percent of water flowing through each component of the system, and the concentration of the TDS.



Component	*Total Flow (%)*	*TDS (mg/L)*
A	100	800
B	100	800
C	25	800
D	75	800
E	55	10
F	20	3,500
G	80	250

Figure 5D.9.1.
Flow Diagram for a Typical Groundwater Desalination Water Treatment Plant

[1] TWDB, "Desalination: Brackish Groundwater," April 2019 http://www.twdb.texas.gov/publications/shells/Desal_Brackish.pdf

5D.9.1 City of Alice- Jasper Wellfield

5D.9.1.1 Description of Strategy

The City of Alice is pursuing Brackish Groundwater Desalination of groundwater supplies from the Jasper formation within the Gulf Coast Aquifer to diversify their water supplies. The 2016 Region N Plan included this project as a recommended water management strategy. Since the 2016 Plan, the City of Alice has continued to study this project towards phased implementation as follows:

- The City of Alice received Drinking Water State Revolving Fund (DWSRF) funding which are being used to construct Phase I. Phase I is in progress, including planning, engineering, permitting, environmental, and construction of test well & production well.
- Phase II will follow with construction of a 3.0 million gallon per day brackish desalination plant, one 2 million gallon per day brackish production well, building, yard piping, well construction lines and concentrate discharge line. The City rolled forward the project information form submitted to TWDB for Phase II, for consideration during TWDB's 2021 fiscal year for DWSRF funding.
- The City of Alice issued an RFP for alternate groundwater delivery services for Phase II and received two proposals. At the August 18, 2020 City Council Meeting, the City Council authorized the City Manager to negotiate with Seven Seas for financing, designing, building, owning, operating and maintaining the brackish desalination plant. According to Seven Seas, plant is estimated to be fully operational in 18 months after construction begins (https://sevenseaswater.com/seven-seas-water-selected-as-winning-bidder-for-p3-brackish-water-desalination-plant-in-texas/)

The description below reflects the current City of Alice plans to drill 2 wells to supply up to 3 MGD finished water, after treatment.

The proposed layout of the brackish groundwater desalination project is shown in Figure 5D.9.2. The first project phase includes drilling and testing of a production well near Alice's existing Water Treatment Plant (WTP) and performing blending analyses affecting future supply integration. The results of the first phase will then be used to design Phase 2, which will include drilling a second well, pipeline infrastructure, and construction of a desalination plant.

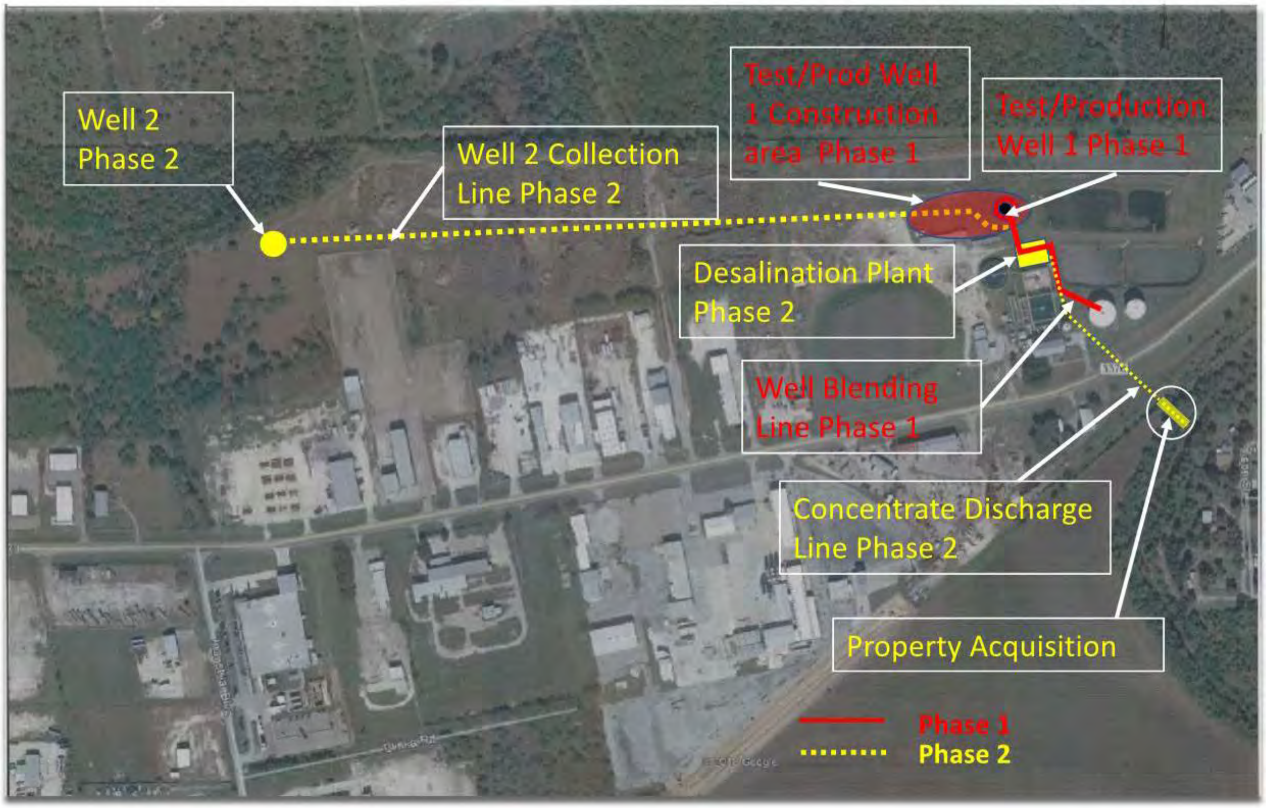


Figure 5D.9.2.
City of Alice Brackish Desalination Plant Layout

The proposed wells are located near the existing Alice WTP located on FM 3376. Based on geologic data for the Jasper Aquifer in this area, it is estimated the total dissolved solids (TDS) of the raw groundwater is 1,600 to 2,100 mg/L, with a maximum of 3,000 mg/L. A total of 2 wells to an approximate depth of 1,700 ft will be drilled to produce a raw supply of 4 million gallons per day (mgd), and finished supply of 3 mgd (3,363 ac-ft/yr). Given that the expected TDS of the groundwater exceeds current drinking water standards, a desalination treatment facility is necessary to treat the water prior to distribution.

This project will fit within current modeled available groundwater (MAG) restrictions without over-drafting. The TDS levels for finished water supply for distribution is estimated at 400 to 600 mg/L. The brine concentrate generated during the treatment process will be directed to a common header routed for discharge to the San Diego Creek, an intermittent stream that flows into San Fernando Creek which is a freshwater tributary to Baffin Bay, 70 miles downstream of Corpus Christi. The brine disposal approach is the same, as shown in the 2016 Region N Plan.

5D.9.1.2 Available Yield

As part of the study conducted by the City, wells in the area of the proposed site were analyzed. Existing abandoned wells in the area are 800 to 900 ft deep and the most productive depth of the Jasper formation in the area according to the City of Alice's study is between 1,600 to 1,800 ft deep. Wells at this depth are estimated to produce up to 2 mgd each (1,309 gpm). The raw water TDS concentrations in the area are estimated at between 1,600 and 2,100 mg/L. It is proposed to have 2 wells that are expected to produce a combined total of 4 million gallons per day (MGD), for a finished supply of 3,363 ac-ft/yr (3 MGD) with a product water quality of 400-600 mg/L for TDS. This project will fit within current MAG restrictions without over drafting. Prior to final design, test wells will be drilled to confirm the groundwater yield and quality.

5D.9.1.3 Environmental Issues

Plans for the proposed water management strategy include primary well locations at the City of Alice's existing WTP located on FM 3376 with alternate well locations on the existing Lake Findley site. The primary environmental issues related to the development of brackish groundwater desalination of water from the Jasper Aquifer in Jim Wells County are the development of 2 brackish water wells (either at the Alice WTP or Findley site), development of brackish water treatment facilities, collection pipelines and a concentrate discharge line, and discharge of brine concentrate into San Diego Creek. San Diego Creek is an intermittent stream that flows into San Fernando Creek, which is a freshwater tributary to Baffin Bay 70 miles downstream of Corpus Christi. With limited freshwater inflow, evaporation far exceeds precipitation in the bay, resulting in a hypersaline estuary.

Estuaries such as those found near Baffin Bay serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from their large nutrient input, shallow water, and the ability of a few marine species to thrive in environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the disposal of brine concentrate from the City of Alice brackish water project will be sensitive to the siting of the project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to San Fernando Creek and the Bay system would need to be performed.

The proposed project area is located within the Coastal Prairies sub-province of the larger Gulf Coastal Plains of Texas Physiographic Province. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

The proposed project Alice WTP site and concentrate disposal pipelines would be within areas characterized primarily as urban high intensity, with smaller areas of coastal prairie, floodplain evergreen forest and woodland and native invasive huisache woodland or shrubland near San Diego Creek. The alternate Findley site, would be sited in areas characterized as coastal prairie and floodplain evergreen forest and woodland. Although the construction of the brine disposal or collection pipelines may include clearing and removal of woody vegetation, destruction of potential habitat can be minimized by siting the corridor within previously disturbed areas, where possible.

Area Vegetation and Wildlife Habitat

The City of Alice is located within the South Texas Plains Vegetational Area. The South Texas Plains and brush country averages between 20-32 inches of rainfall per year with high summer temperatures and very high evaporation rates. Plains with thorny shrubs and trees dominate the region, with scattered patches of palms and subtropical woodlands in the Rio Grande Valley. Thorny brush, such as mesquite, acacia and prickly pear are the primary vegetation mixed with areas of grassland.[2] Historically, the plains were covered with open grasslands with few trees, and the Valley woodlands covered large areas.

Threatened and Endangered Species (ES)

The Federal Endangered Species Act of 1973, as amended, prohibits the "take" of any threatened or endangered species. The term "take" under the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." The term "harm" was further defined to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the project area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Construction activities could disturb migratory bird habitats and/or species' activities and care should be taken to avoid impacts to migratory birds and active nests.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project's activities on threatened and endangered species, as well as bald eagles. Species' locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service and TPWD recommendations.

In Jim Wells County, 24 state-listed endangered or threatened species and seven federally-listed endangered or threatened wildlife species may occur, according to the county lists of rare species published by the TPWD. A list of these species, including species of greatest conservation need (SGCN) and rare species, their preferred habitat, and potential occurrence in Jim Wells County is provided in Table 5D.9.1.

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[2] TPWD, 2019. South Texas Plains. Accessed online https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions/south-texas-plains November 3, 2019.

Table 5D.9.1. Federal- and State-Listed Threatened, Endangered, and Species of Concern Listed for Jim Wells County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	*Notophthalmus meridionalis*	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Sometimes in wet areas, such as arroyos, canals, ditches or shallow depressions.	Resident	—	T
Sheep frog	*Hypopachus variolosus*	Predominantly grassland and savanna. Largely fossorial in areas with moist microclimates.	Resident	—	T
South Texas siren (large form)	*Siren sp. 1*	Mainly in quiet bodies of water, permanent or temporary, with or without submergent vegetation. Wet or sometimes wet areas.	Resident	—	T
Strecker's chorus frog	*Pseudacris streckeri*	Wooded floodplains and flats, prairies, cultivated fields and marshes.	Resident	—	SGCN
Bald Eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes, nests in tall trees or on cliffs near water.	Resident	—	T
Botteri's Sparrow	*Peucaea botterii*	Habitat description not available.	Resident	—	T
Franklin's Gull	*Leucophaeus pipixcan*	Habitat description not available.	Resident	—	SGCN
Interior Least Tern	*Sternula antillarum athalassos*	Sand and gravel bars within braided streams, rivers or man-made structures.	Resident	LE	E
Mountain Plover	*Charadrius montanus*	Nests on high plains or shortgrass prairie. Nonbreeding – shortgrass plains and bare, dirt (plowed) fields.	Resident	—	SGCN
Piping Plover	*Charadrius melodus*	Beaches, sandflats, and dunes along Gulf Coast beaches.	Transient	LT	T
Reddish egret	*Egretta rufescens*	Resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats.	Resident	—	T
Swallow-tailed Kite	*Elanoides forficatus*	Lowland forested regions, especially swampy areas, ranging into open woodland. Marshes, along rivers, lakes and ponds.	Resident	—	T
Texas Botteri's Sparrow	*Peucaea botterii texana*	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca.	Resident	—	T
Tropical Kingbird	*Tyrannus melancholicus*	Habitat description not available at this time.	Resident	—	—
Western Burrowing Owl	*Athene cunicularia hypugaea*	Open grasslands, especially prairie, plains, and savanna. Sometimes in open areas like vacant lots or airports.	Resident	—	SGCN
White-faced Ibis	*Plegadis chihi*	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats.	Resident	—	T
White-tailed Hawk	*Buteo albicaudatus*	Near coast on prairies, cordgrass flats, and scrub-live oak. Further inland on prairies, mesquite and oak savannas and mixed savanna-chaparral.	Resident	—	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Whooping Crane	*Grus americana*	Small ponds, marshes, and flooded grain fields. Potential migrant via plains through much of state.	Migrant	LE	E
Wood Stork	*Mycteria americana*	Nests in large tracts of baldcypress or red mangrove. Forages in prairie ponds, flooded pastures or fields, ditches or other shallow standing water.	Resident	—	T
American eel	*Anguilla rostrata*	Large rivers, streams, tributaries, coastal watersheds, estuaries, bays and oceans. Habitat generalists.	Aquatic Resident	—	SGCN
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time.	Resident	—	SGCN
Manfreda giant-skipper	*Stallingsia maculosus*	Larvae feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk.	Resident	—	SGCN
No accepted common name	*Pediodectes pratti*	Habitat description is not available at this time.	Resident	—	SGCN
American badger	*Taxidea taxus*	Habitat description is not available at this time.	Resident	—	SGCN
Big free-tailed bat	*Nyctinomops macrotis*	Prefers to roost in crevices and cracks in high canyon walls, but will use buildings as well.	Resident	—	SGCN
Cave myotis bat	*Myotis velifer*	Colonial and cave-dwelling, also roosts in rock crevices, old buildings, carports, under bridges and old cliff swallow nests.	Resident	—	SGCN
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas, usually associated with wooded areas. Found in towns especially during migration.	Resident	—	SGCN
Eastern spotted skunk	*Spilogale putorius*	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands.	Resident	—	SGCN
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodland in Trans Pecos, forests and woods in east and central Texas.	Resident	—	SGCN
Long-tailed weasel	*Mustela frenata*	Brushlands, fence rows, upland woods and bottomland hardwoods, forest edges, and rocky desert scrub. Usually live close to water.	Resident	—	SGCN
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	Resident	—	SGCN
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones.	Resident	—	SGCN
Ocelot	*Leopardus pardalis*	Restricted to mesquite-thorn scrub and live-oak mottes, avoids open areas.	Transient	LE	E
Plains spotted skunk	*Spilogale putorius interrupta*	Open fields, prairies, croplands, fence rows, forest edges and woodlands.	Resident	—	—
Southern yellow bat	*Lasiura ega*	Relict palm grove is only known Texas habitat.	Transient	—	T
Tricolored bat	*Perimyotis subflavus*	Forest, woodland and riparian areas. Caves are very important.	Resident	—	SGCN

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Western hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands and deserts, most common in rugged, rocky canyon country.	Resident	—	SGCN
Western spotted skunk	*Spilogale gracilis*	Habitat description is not available at this time.	Resident	—	SGCN
White-nosed coati	*Nasua narica*	Woodlands, riparian corridors, and canyons.	Transient	—	T
Golden orb	*Quadrula aurea*	Sand and gravel in some locations, mud at others. Found in lentic and lotic, Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Resident	C	T
No accepted common name	*Praticolella candida*	Habitat description is not available at this time.	Resident	—	SGCN
American alligator	*Alligator mississippiensis*	Coastal marshes, inland natural rivers, swamps and marshes, manmade impoundments.	Resident	—	—
Kelled earless lizard	*Holbrookia propinqua*	Coastal dunes, barrier islands, and other sandy areas.	Resident	—	SGCN
Massasauga	*Sistrurus tergeminus*	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Resident	—	SGCN
Mexican blackhead snake	*Tantilla atriceps*	Shrubland savanna.	Resident	—	SGCN
Slender glass lizard	*Ophisaurus attenuatus*	Prefers relatively dry microhabitats, usually associated with grassy areas.	Resident	—	SGCN
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	Habitat description is not available at this time.	Resident	—	SGCN
Spot-tailed earless lizard	*Holbrookia lacerata*	Moderately open prairie-brushland, fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Resident	—	SGCN
Texas horned lizard	*Phrynosoma cornutum*	Open, arid and semi-arid regions with sparse vegetation.	Resident	—	T
Texas indigo snake	*Drymarchon melanurus erebennus*	Thornbrush-chaparral woodland, in particular dense riparian corridors. Can do well in irrigated croplands.	Resident	—	T
Texas scarlet snake	*Cemophora coccinea lineri*	Along Gulf Coast, know from mixed hardwood scrub on sandy soils.	Resident	—	T
Texas tortoise	*Gopherus berlandieri*	Open brush with a grass understory is preferred.	Resident	—	T
Western box turtle	*Terrapene ornata*	Prairie grasslands, pasture, fields, sandhills and open woodland.	Resident	—	SGCN
Western hognose snake	*Heterodon nasicus*	Areas with sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, semi-agricultural areas, thronscrub woodlands and chaparral thickets.	Resident	—	SGCN
Amelia's sand-verbena	*Abronia ameliae*	Deep, well-drained sandy soils of the South Texas Sand Sheet in grassy and/or herbaceous dominated openings within woodlands.	Resident	—	SGCN
Bailey's ballmoss	*Tillandsia baileyi*	Epiphytic on various trees and tall shrubs.	Resident	—	SGCN

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Billie's bitterweed	*Tetraneuris turneri*	Grasslands on shallow sandy soils and caliche outcrops.	Resident	—	SGCN
Black lace cactus	*Echinocereus reichenbachii var. albertii*	Grasslands, thorn shrublands, mesquite woodlands on sandy, somewhat saline soils on coastal prairie.	Resident	LE	E
Croft's bluet	*Houstonia croftiae*	Occurs in sparsely vegetated areas in grasslands or among shrubs.	Resident	—	SGCN
Drummond's rushpea	*Caesalpinia drummondii*	Open areas on sandy clay.	Resident	—	SGCN
Elmendorf's onion	*Allium elmendorfii*	Grassland openings in oak woodlands on deep, loose, well-drained soils.	Resident	—	SGCN
Falfurrias milkvine	*Matelea radiate*	Uncertain, only two known specimens. One from clay soil on dry gravel hills. Other from Falfurrias with no habitat description.	Potential Resident	—	SGCN
Greenman's bluet	*Houstonia parviflora*	Habitat description is not available at this time.	Resident	—	SGCN
Low spurge	*Euphorbia peplidion*	Occurs in a variety of vernally-moist situations in a number of natural regions.	Resident	—	SGCN
Net-leaf bundleflower	*Desmanthus reticulatus*	Mostly on clay prairies of the coastal plain.	Resident	—	SGCN
Plains gumweed	*Grindelia oolepis*	Coastal prairies on heavy clay soils, often in depressional areas.	Resident	—	SGCN
Sand Brazos mint	*Brazoria arenaria*	Sandy areas in South Texas.	Resident	—	SGCN
South Texas ambrosia	*Ambrosia cheiranthifolia*	Grasslands and mesquite-dominated shrublands on various soils ranging from heavy clays to lighter textured sandy loams.	Resident	LE	E
South Texas gilia	*Gilia ludens*	Open areas in shrublands on shallow sandy loam over rock outcrops.	Resident	—	SGCN
South Texas rushpea	*Caesalpinia phyllanthoides*	Tamaulipan thorn shrublands or grasslands on very shallow sandy to clayey soils over calcareous sandstone caliche.	Resident	—	SGCN
Texas peachbush	*Prunus texana*	Scattered sites in various well drained sandy situations.	Resident	—	SGCN
Yellow-flowered alicoche	*Echinocereus papillosus*	Under shrubs or in open areas on various substrates.	Resident	—	SGCN

Source: TPWD, Annotated County List of Rare Species, Jim Wells County, updated July 17, 2019.

C Federal candidate for listing
SGCN Species of Greatest Conservation Need
— Not Listed (Species of Concern)
T State Threatened
LE Federally listed endangered
LT Federally listed threatened
E State Endangered

Inclusion in Table 5D.9.1 does not imply that a species will occur within the project area, but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed project would occur primarily in areas which have been previously developed at the existing WTP, infrastructure right-of-way, and used for farming or pasture for a long period of time. Disturbance within these areas due to construction of the pipeline routes and wells is anticipated to have minimal effect on the existing environment. Impacts from the disposal of saline concentrate into the intermittent flowing San Diego Creek, eventually leading to Baffin Bay, should be carefully monitored in order to minimize any impacts this may have on aquatic species. After a review of the habitat requirements for each listed species, it is anticipated that it is unlikely that this project will have an adverse effect on any federally listed threatened or endangered species, its habitat, or designated habitat, nor would it adversely affect any state endangered species. Although suitable habitat for some listed species may exist within the project areas, no impact is anticipated due to the abundance of similar habitat near the project areas and the ability of most species to relocate to those areas if necessary. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetlands could occur within the project area, especially near San Diego Creek and surrounding Lake Findley. The wells, collection lines, desalination plant, and concentrate discharge lines should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by selective property acquisition and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable.

Cultural Resources

A review of the Texas Historical Commission Texas Historic Sites Atlas data base indicated that there are no National Register Properties, Historical Markers, or cemeteries located near the proposed or alternate project areas. A cultural resource survey of the well field and pipeline routes for each of the proposed project areas will need to be performed consistent with requirements of the Texas Historical Commission.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

The pumping of groundwater from the Jasper Aquifer could cause a slight reduction on baseflow in downstream reaches. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent. Salinity concentrations in San Diego Creek and farther downstream should be carefully monitored in order to minimize any impacts this may have on aquatic species.

5D.9.1.4 Engineering and Costing

Two wells were assumed at a depth of 1,700 feet with an average flow of 1,400 gpm. Less than 1 mile of 18-inch diameter piping was used for transmission from the wells to the treatment facilities. Total project costs for the two wells and associated infrastructure totaled $23,983,000. Assuming a 20 year debt service at a rate of 3.5% an annual cost of 3,932,000 was estimated. With a finished water project yield of 3,360 ac-ft/yr, a unit cost of $1,170/ac-ft of supply can be seen in Table 5D.9.2. The treatment consists of a brackish desalination plant that will treat water of up to 3,000 mg/L at a capacity of 3 mgd. The final design will stabilize the reverse osmosis water by bypassing and blending a portion of the raw brackish groundwater with the permeate water. The proportion of the blend will be determined when the final water well water quality is confirmed to reach the desired goal. A degasifier system will be used to strip unwanted gas, such as carbon dioxide and hydrogen sulfide, from the permeate water, thereby utilizing fewer chemicals and reducing O&M costs. A stabilization system will be used to properly condition the water supply so that it is not corrosive before it is delivered into the finished water transmission and distribution systems. The product water would then be delivered to processes for disinfection and storage in the existing ground storage tanks.

Table 5D.9.2.
Cost Estimate Summary Water Supply Project Option (Sept 2018 Prices), City of Alice-Jasper Well Field

Item	Estimated Costs for Facilities
Pump Station (3 MGD)	$450,000
Pipelines (Transmission and Concentrate Disposal)	$505,000
Well Fields (Production Wells, Test Well, and Pumps)	$4,408,000
Water Treatment Plant (3 MGD)	$11,140,000
SCADA	$525,000
Total Cost of Facilities	**$17,028,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,935,000
Environmental & Archaeology Studies and Mitigation	$190,000
Land Acquisition and Surveying (21 acres)	$188,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$642,000
Total Cost of Project	**$23,983,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$1,687,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$54,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$11,000
Water Treatment Plant	$2,150,000
Pumping Energy Costs (375185 kW-hr @ 0.08 $/kW-hr)	$30,000
Purchase of Water (acft/yr @ $/acft)	$0
Total Annual Cost	**$3,932,000**
Available Project Yield (acft/yr)	3,360
Annual Cost of Water ($ per acft)	$1,170
Annual Cost of Water After Debt Service ($ per acft)	$668
Annual Cost of Water ($ per 1,000 gallons)	$3.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.05

Note: One or more cost element has been calculated externally

Dissolved minerals rejected by the RO membranes (concentrate) will be concentrated by each RO train at a rate of 1 mgd by volume. The concentrate will be discharged to property acquired on San Diego Creek.

5D.9.1.5 Implementation Issues

There are several considerations for the City of Alice Brackish Groundwater Desalination Project to include:

- Permitting desalination concentrate discharge to San Fernando Creek and Baffin Bay;
- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Purchase or lease of property for well field, and coordination with landowners;
- Skilled operators of desalination water treatment plants;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- General Land Office Easement for use of State-owned lands, if any;
- Texas Parks and Wildlife Department Sand, Gravel, and Marl permit; and
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

5D.9.1.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.9.3.

Table 5D.9.3.
Evaluation Summary of the City of Alice Brackish Groundwater Desalination Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield: 3,360 ac-ft/yr.
2. Reliability 3. Cost of treated water	2. High reliability. 3. Generally moderate to high cost; $1,160 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None to low impact. Non-continuous flow in San Diego Creek. Monitor impacts of saline discharge.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Moderate impact. However, greatest impact is during low-flow conditions to Baffin Bay.
3. Wildlife habitat	3. Disposal of concentrated brine may impact wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be evaluated. 7d-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Potential impacts to agricultural or seasonal water use from San Fernando Creek associated with brine discharge. These impacts will likely intensify if non-potable reuse project (5D.9) is implemented and WWTP discharge are reduced or eliminated. • Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Brackish groundwater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

5D.9.2 Evangeline/Laguna LP Treated Groundwater Project

5D.9.2.1 Description of Strategy

The Evangeline/Laguna LP Groundwater Project includes groundwater production of up to 25.4 MGD (28,486 acft/yr) from 23,000+ acres located in San Patricio County for conveyance to a proposed groundwater desalination treatment plant, and delivery to the City of Corpus Christi and/or future industries in San Patricio County. Figure 5D.9.3 shows the approximate location of the project site. Since the 2016 Plan, project developers have moved this project towards implementation by securing permits from the San Patricio County Groundwater Conservation District (SPCGCD), drilling and collecting data from a test well, and performing a corrosion analysis, but no blending analysis has been conducted yet. The test well water quality results were all within TCEQ drinking water standards. TDS and chloride levels measured at the test well were 792 mg/L and 269 mg/L, respectively. The SPCGCD production permit granted to Evangeline/Laguna LP is for up to 25.4 MGD (28,486 acft/yr), the current MAG for regional planning purposes limits groundwater production in San Patricio County to 24,873 acft/yr in Year 2020. However, in Year 2050, the full groundwater production equal to the 25.4 MGD permit issued by the SPCGCD is available under regional planning guidelines.

This project has been evaluated in two ways for the 2021 Region N Plan: (a) as a raw, groundwater supply with minimal treatment (Chapter 5D.8.2) and (b) with groundwater desalination to reduce TDS and chlorides to around 200 mg/L for high water quality use. **The strategy presented here is for groundwater desalination for a finished water at a quality around 200 mg/L.**

This project will be phased based on MAG limitations, with full well field build-out after 2050 as described above. The first phase is a well field with 13 wells (production constrained by MAG), but at full project production, the wellfield consists of 18 wells including contingency. The wells will be around 1,000 ft and have an estimated pumping rate of 1,200 gpm. The current raw groundwater quality is around 800 mg/L TDS, and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides. The pumped groundwater would be conveyed to a new groundwater desalination plant proposed for location on a property north of the City of Sinton which is part of the Evangeline/Laguna LP project and treated to a finished water goal of 200 mg/L TDS based on future industrial water quality needs. The brine concentrate would be disposed of in Chiltipin Creek downstream of the City of Sinton's WWTP discharge location.

Three delivery options were evaluated as part of this water management strategy and the costs are provided in the Engineering and Costing Section.

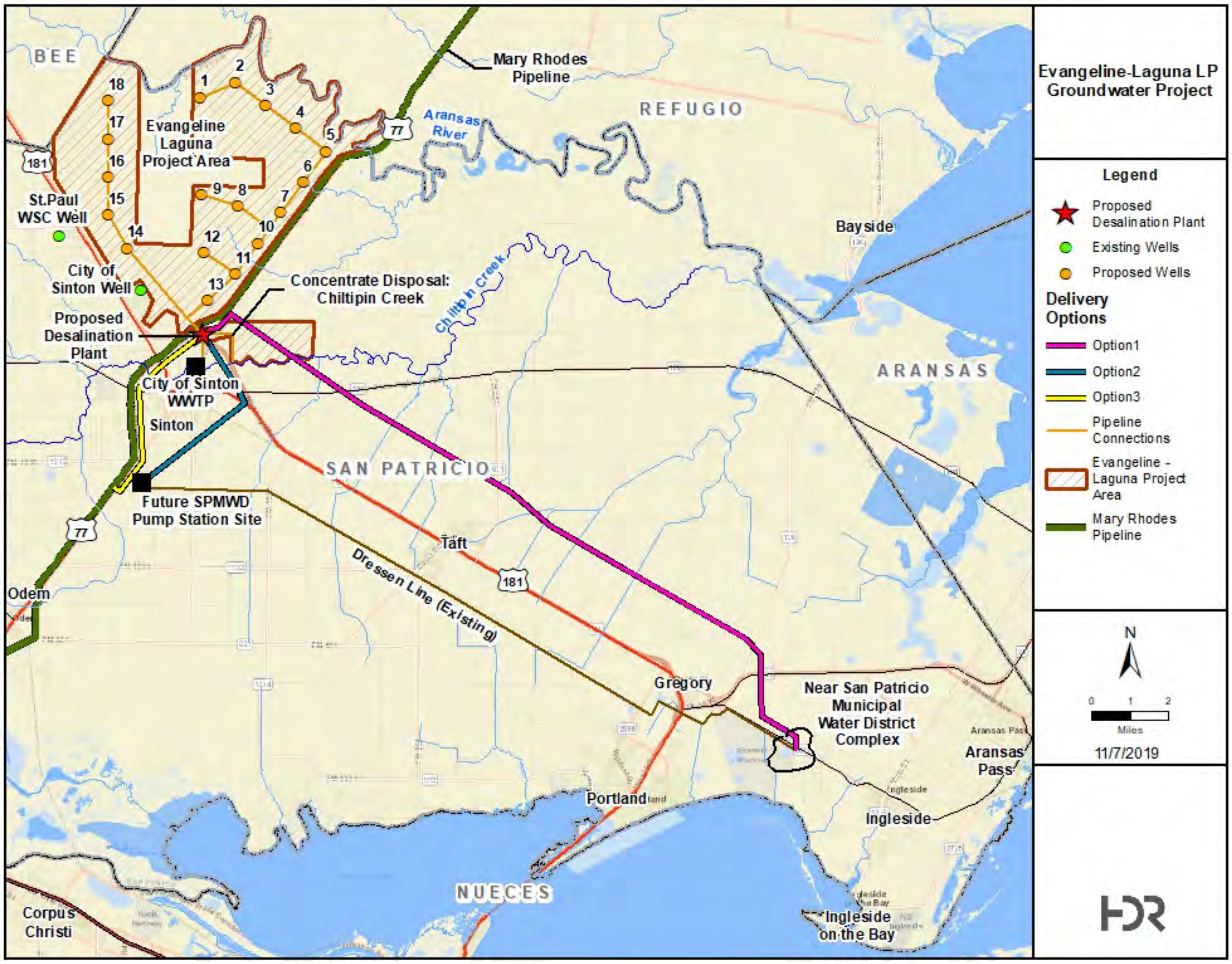

Figure 5D.9.3.
Location of Conceptual Layout of Evangeline/Laguna LP Groundwater Project

5D.9.2.2 Available Yield

In the Coastal Bend region, the Gulf Coast Aquifer System is the primary source of substantial groundwater supplies. The most productive water-bearing zone is the Goliad Sand, also known as the Evangeline Aquifer. The outcrop of the Goliad Sand is about 50 to 75 miles inland. The formation dips toward the coast at about 20 feet per mile. Near the coast, the shallower Chicot Aquifer provides some groundwater supplies. West of the outcrop of the Goliad Sands, the deeper Jasper Aquifer can supply a moderate amount of groundwater in some areas.

The SPCGCD production permit granted to Evangeline/Laguna LP is for up to 25.4 MGD (28,486 acft/yr), the current MAG for regional planning purposes limits groundwater production in San Patricio County to 24,873 acft/yr in Year 2020. However, in Year 2050, the full groundwater production equal to the 25.4 MGD permit issued by the SPCGCD is available under regional planning guidelines.

5D.9.2.3 Environmental Issues

The primary environmental issues related to the development of groundwater desalination of water from the Evangeline Aquifer in San Patricio County are the development of the well fields and associated pipelines, development of water treatment facilities, integration into the existing pipeline system and discharge of brine concentrate into bay areas.

The project is located in the Gulf Coastal Plains of Texas Physiographic Province, specifically in the subprovince of the Coastal Prairies. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

Environmental Considerations Associated with Evangeline-Laguna LP Groundwater Project

The Evangeline-Laguna LP Groundwater project includes a well field of 18 water wells located in San Patricio County near its border with Bee County. Water would either be minimally treated and delivered, or would require a potential desalination water treatment plant located adjacent to the well field, near Sinton. Concentrate disposal for this project would be to Chiltipin Creek.

Three delivery pipeline options are proposed. The proposed transmission pipelines cross areas which are primarily used for pasture and crops. Vegetation types found along the pipeline route also include areas of Mesquite-Live Oak-Bluewood Parks. The concentrate disposal pipeline would cross possible wetland areas associated with Chiltipin Creek. Planning of the pipeline route should include avoidance of impacts to wetland areas where possible. The potential environmental effects resulting from the disposal of brine concentrate from the Evangeline/Laguna LP Groundwater project will be sensitive to the siting of the project and its associated pipeline and the concentration and quantity of brine effluent in relation to stream flows. Although the construction of portions of the treated water pipeline may include the clearing and removal of woody vegetation, destruction of potential habitat can generally be avoided by diverting the corridor through previously disturbed areas.

Estuaries such as those found near Copano Bay serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from their large nutrient input, shallow water, and the ability of a few marine species to thrive in environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the disposal of brine concentrate from the project will be sensitive to the siting of the project and its appurtenances. The salinity level of the discharged concentrate is expected to be lower[3] than that of the water found within the Copano Bay system, which should minimize its impact on the associated aquatic habitat. Prior to

[3] Varies based on finished water quality needs.

implementation, additional water quality studies of discharge impacts to the Chiltipin Creek and the Bay system would need to be performed.

The well field area is primarily located within an area used for crops; however, it also contains smaller portions of Mesquite-Live Oak-Bluewood Parks vegetation areas. Mesquite-Live Oak-Bluewood Parks areas commonly contain plants such as huisache, grajeno, lotebush, pricklypear, agarita, purple threeawn, and Mexican persimmon. Distribution of this vegetation type is found primarily within the South Texas Plains. Site selection for the wells should include the avoidance of impacts to wetland areas.

Appropriate pipeline route selection, construction methods and right-of-way selection should avoid or minimize anticipated impacts to potential wetland areas or other waters of the U.S. along the three treated water pipeline options.

Area Vegetation and Wildlife Habitat

The groundwater desalination project area is located within the Gulf Prairies and Marshes Vegetational Area. Gulf Prairies have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However tree species such as honey mesquite, and acacia, along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak (*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), black-brush (*A. rigidula*), and a dwarf shrub; bushy sea-ox-eye (*Borrichia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiangrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Prickleypear (*Opunita* sp.) are common within this area along with forbs including asters (*Aster* sp.), poppy mallows (*Callirhoe* sp.), bluebonnets (*Lupinus* sp.), and evening primroses (*Oenothera* sp.). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus* sp.), bulrushes (*Scirpus* sp.), rushes (*Juncus* sp.), and grasses. Aquatic forbs found in these areas generally include pepperweeds (*Lepidium* sp.), smartweeds (*Polygonum* sp.), cattails (*Typha domingensis*) and spiderworts (*Tradescantia* sp.) among others. Game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

Threatened and Endangered Species (ES)

The Federal Endangered Species Act of 1973, as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act.

Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the pipeline area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Pipeline construction activities could disturb migratory bird habitats and/or species' activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project's activities on threatened and endangered species, as well as bald eagles. Species' locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service and TPWD recommendations.

In San Patricio County, there may occur 40 state-listed endangered or threatened species and 19 federally-listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat and potential occurrence in the four county areas is provided in Table 5D.9.4.

Table 5D.9.4.
Federal- and State-Listed Threatened, Endangered, and Species of Concern Listed for San Patricio County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	*Notophthalmus meridionalis*	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	*Hypopachus variolosus*	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	*Siren sp. 1*	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Strecker's chorus frog	*Pseudacris streckeri*	Wooded floodplains and flats, prairies, cultivated fields and marshes.	Resident	--	--
Bald eagle	*Haliaeetus leucocephalus*	Found primarily near rivers and large lakes, nests in tall trees or on cliffs near water.	Resident	--	T
Black rail	*Laterallus jamaicensis*	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	PT	--
Botteri's sparrow	*Peucaea botterii*	Habitat description is not available at this time.	Resident	--	T
Eskimo Curlew	*Numenius borealis*	Nonbreeding in grasslands, pastures and plowed fields	Historic	LE	E
Franklin's gull	*Leucophaeus pipixcan*	Habitat description is not available at this time.	Migrant	—	—

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Mountain plover	*Charadrius montanus*	Breeding, nesting on shortgrass prairie	Resident	—	—
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus	Migrant	LE	E
Piping plover	*Charadrius melodus*	Beaches and flats of coastal Texas	Migrant	LT	T
Red knot	*Calidris canutus rufa*	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	LT	--
Swallow-tailed kite	*Elanoides forficatus*	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
Texas Botteri's Sparrow	*Aimophila botterii texana*	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses	Resident	—	T
Tropical kingbird	*Tyrannus melancholicus*	Habitat description is not available at this time	Resident	--	--
Tropical parula	*Setophaga pitiayumi*	Semi-tropical evergreen woodland along rivers and resacas	Resident	--	T
Western burrowing owl	*Athene cunicularia hypugaea*	Open grasslands, especially prairie	Resident	—	—
White-faced ibis	*Plegadis chihi*	Prefers freshwater marshes	Resident	—	T
White-tailed hawk	*Buteo albicaudatus*	Coastal prairies, savannahs and marshes in Gulf Coastal Plain	Nesting/Migrant	—	T
Whooping crane	*Grus Americana*	Winters in coastal marshes	Migrant	LE	E
Wood stork	*Mycteria Americana*	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas	Migrant	—	T
Opossum pipefish	*Microphis brachyurus*	Brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth.	Aquatic Resident	--	T
Snook	*Centropomus undecimalis*	Habitat description is not available at this time	Aquatic Resident	--	--
Southern flounder	*Paralichthys lethostigma*	Habitat description is not available at this time	Aquatic Resident	--	--
American bumblebee	*Bombus pensylvanicus*	Habitat description is not available at this time	Resident	--	--
Manfreda giant-skipper	*Stallingsia maculosus*	Most skippers are small and stout-bodied; name derives from fast, erratic flight	Resident	—	—
No accepted common name	*Disonycha stenosticha*	Habitat description is not available at this time	Resident	—	—
No accepted common name	*Dacoderus steineri*	Habitat description is not available at this time	Resident	—	—
No accepted common name	*Cryptocephalus downiei*	Habitat description is not available at this time	Resident	—	—

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
No accepted common name	*Ormiscus albofasciatus*	Habitat description is not available at this time	Resident	___	___
No accepted common name	*Ceophengus pallidus*	Habitat description is not available at this time	Resident	___	___
American badger	*Taxidea taxus*	Habitat description is not available at this time	Resident	___	___
Big free-tailed bat	*Nyctinomops macrotis*	Roosts in crevices and cracks in high canyon walls, but will use buildings as well.	Resident	--	--
Cave myotis bat	*Myotis velifer*	Colonial and cave dwelling, also roosts in rock crevices, old buildings, carports, and under bridges	Resident	--	--
Eastern red bat	*Lasiurus borealis*	Found in a variety of habitats in Texas. Usually associated with wooded areas.	Resident	--	--
Eastern spotted skunk	*Spilogale putorius*	Catholic, open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	Resident	--	--
Hoary bat	*Lasiurus cinereus*	Known from montane and riparian woodland in Trans-Pecos, forest and woods in east and central Texas.	Resident	--	--
Humpback whale	*Megaptera novaeangliae*	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	LE	E
Long-tailed weasel	*Mustela frenata*	Brushlands, fence rows, upland woods and bottomland hardwoods, forest edges, and rocky desert scrub	Resident	--	--
Maritime pocket gopher	*Geomys personatus maritimus*	Fossorial in deep sandy soils.	Resident	--	--
Mexican free-tailed bat	*Tadarida brasiliensis*	Found in all habitats, forest to desert.	Resident	--	--
Mountain lion	*Puma concolor*	Rugged mountains and riparian zones	Resident	--	--
Ocelot	*Leopardus pardalis*	Dense chaparral thickets; mesquite-thorn shrub and live oak stands	Resident	LE	E
Plains spotted skunk	*Spilogale putorius interrupta*	Open fields, and prairies	Resident	___	___
Southern yellow bat	*Lasiurus ega*	Associated with trees, such as palm trees	Resident	___	T
Swamp rabbit	*Sylvilagus aquaticus*	Habitat description is not available at this time.	Resident	--	--
Tricolored bat	*Perimyotis subflavus*	Forest, woodland, and riparian areas are important. Caves are very important	Resident	--	--
Western hog-nosed skunk	*Conepatus leuconotus*	Woodlands, grasslands, and deserts to 7,200 feet.	Resident	--	--
White-nosed coati	*Nasua narica*	Woodlands, riparian corridors and canyons	Transient	___	T
Golden Orb	*Quadrula aurea*	Sand and gravel areas in river basins	Resident	C	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
No accepted common name	_Praticolella candida_	Habitat description is not available at this time	Resident	--	--
American alligator	_Alligator mississippiensis_	Coastal marshes, inland natural rivers and marshes, manmade impoundments	Resident	--	--
Atlantic hawksbill sea turtle	_Eretmochelys imbricata_	Gulf and bay system, warm shallow waters especially in rocky marine environments	Aquatic Resident	LE	E
Common garter snake	_Thamnophis sirtalis_	Irrigation canals and riparian-corridor farmlands in west. Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water, coastal salt marshes.	Resident	--	--
Eastern box turtle	_Terrapene carolina_	Forests, fields, forest-brush and forest-field ecotones.	Resident	--	--
Green sea turtle	_Chelonia mydas_	Gulf and bay systems; shallow water seagrass beds	Aquatic Resident	LT	T
Keeled earless lizard	_Holbrookia propinqua_	Coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates	Resident	—	—
Loggerhead sea turtle	_Caretta caretta_	Gulf and bay systems for juveniles, adults prefer open waters	Aquatic Resident	LT	T
Massasauga	_Sistrurus tergeminus_	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Resident	--	--
Northern scarlet snake	_Cemophora coccinea coperi_	Along Gulf Coast, known from mixed hardwood scrub on sandy soils.	Resident	--	T
Slender glass lizard	_Ophisaurus attenuatus_	Open grassland, prairie, woodland edge, open woodland, oak savannas, longleaf pine flatwoods, scrubby areas, fallow fields, and areas near streams and ponds.	Resident	--	--
Southern spot-tailed earless lizard	_Holbrookia lacerata subcaudalis_	Habitat description is not available at this time.	Resident	--	--
Spot-tailed earless lizard	_Holbrookia lacerate_	Open prairie-brushland	Resident	—	—
Texas diamondback terrapin	_Malaclemys terrapin littoralis_	Coastal marshes and tidal flats	Resident	—	—
Texas horned lizard	_Phrynosoma cornutum_	Varied; sparsely vegetated uplands, grass, cactus, brush	Resident	—	T
Texas Indigo snake	_Drymarchon melanurus erebennus_	Thornbrush-chapparal woodland of south Texas, in particular dense riparian corridors. Can do well in suburban and irrigated croplands.	Resident	--	T
Texas scarlet snake	_Cemophora coccinea lineri_	Mixed hardwood scrub on sandy soils	Resident	—	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Texas tortoise	*Gopherus berlandieri*	Open bush with grass understory; open grass and bare ground avoided	Resident	—	T
Timber/Canebrake rattlesnake	*Crotalus horridus*	Floodplains, riparian zones with dense ground cover	Resident	—	T
Western box turtle	*Terrapene ornate*	Prairie grassland, pasture, fields, sandhills, and open woodland.	Resident	--	--
Arrowleaf milkvine	*Matelea sagittifolia*	Most consistently encountered in thronscrub in south Texas.	Resident	--	--
Billie's bitterweed	*Tetraneuris turneri*	Grasslands on shallow sandy soils and caliche outcrops.	Resident	--	--
Coastal gay-feather	*Liatris bracteata*	Endemic to black clay soils of prairie	Resident	—	—
Crestless onion	*Allium canadense var. ecristatum*	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area (Carr 2015)	Resident	--	--
Croft's bluet	*Houstonia croftiae*	Occurs in sparsely vegetated areas in grasslands or among shrubs (Carr 2015)	Resident	--	--
Drummond's rushpea	*Caesalpinia drummondii*	Open areas on sandy clay.	Resident	--	--
Elmendorf's onion	*Allium elmendorfii*	Endemic to grassland openings in woodlands	Resident	—	—
Greenman's bluet	*Houstonia parviflora*	Habitat description is not available at this time.	Resident	--	--
Indianola beakrush	*Rhynchospora indianolensis*	Locally abundant in cattle pastures in some areas (at least during wet years).	Resident	--	--
Jone's rainlilly	*Cooperia jonesii*	Habitat description is not available at this time.	Resident	--	--
Large selenia	*Selenia grandis*	Occurs in seasonally wet clayey soils in open areas.	Resident	--	--
Lila de los Llanos	*Echeandia chandleri*	Shrubs or in grassy openings in subtropical thorn shrublands along Gulf Coast	Resident	—	—
Low spurge	*Euphorbia peplidion*	Occurs in a variety of vernally-moist situations in a number of natural regions.	Resident	--	--
Net-leaf bundleflower	*Desmanthus reticulatus*	Mostly on clay prairies of the coastal plain of central and south Texas.	Resident	--	--
Plains gumweed	*Grindelia oolepis*	Coastal prairies on heavy clay soils	Resident	—	—
Refugio rainlily	*Zephyranthes refugiensis*	Occurs on deep heavy black clay soils or sandy loams in swales or drainages on herbacrous grasslands or shrublands on level to rolling landscapes underlain by the Lissie Formation.	Resident	--	--
Sand Brazos mint	*Brazoria arenaria*	Sandy areas in South Texas.	Resident	--	--
Seaside beebalm	*Monarda maritima*	Occurs in grasslands and pastures on sandy soil near the coast.	Resident	--	--

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
South Texas false cudweed	*Pseudognaphalium austrotexanum*	Habitat description is not available at this time.	Resident	--	--
South Texas spikesedge	*Eleocharis austrotexana*	Occurring in miscellaneous wetlands at scattered locations on the coastal plain.	Resident	--	--
South Texas yellow clammyweed	*Polanisia erosa ssp. Breviglandulosa*	Habitat description is not available at this time.	Resident	--	--
Texsa peachbush	*Prunus texana*	Occurs at scattered sites in various well drained sandy situations.	Resident	--	--
Texas stonecrop	*Lenophyllum texanum*	Found in shrublands on clay dunes (lomas) at the mouth of the Rio Grande and on xeric calcareous rock outcrops at scattered inland sites.	Resident	--	--
Texas wilkommia	*Wilkommia texana var. texana*	Mostly in sparsely vegetated patches within taller prairies on alkaline or saline soils on the Coastal Plain (Carr 2015)	Resident	--	--
Texas windmill-grass	*Chloris texensis*	Texas endemic; sandy to sandy loam soils in bare areas in coastal prairie grassland remnants	Resident	—	—
Tharp's dropseed	*Sporobolus tharpii*	Occurs on barrier islands, shores of lagoons and bays protected by the barrier islands, and on shores of a few near-coastal ponds.	Resident	--	--
Three-flower broomweed	*Thurovia triflora*	Endemic, remnant grasslands and tidal flats	Resident	—	—
Tree dodder	*Cuscuta exaltata*	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmu*s, and *Diospyros* species as well as *Acacia berlandieri* and other woody plants.	Resident	--	--
Velvet spurge	*Euphorbia innocua*	Open or brushy areas on coastal sands and the south Texas Sand Sheet.	Resident	--	--
Welder machaeranthera	*Psilactia heterocarpa*	Grasslands, varying from midgrass coastal prairies, and open mesquite-huisache woodlands.	Resident	--	--
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	Most records from Texas are historical.	Historic Resident	--	--

Source: TPWD, Annotated County List of Rare Species, San Patricio County, July 17, 2019.

PT Proposed Threatened
LT Federally listed threatened
E State Endangered
LE Federally listed endangered
-- Not Listed (Species of Concern)
T State Threatened

Inclusion in Table 5D.9.4 does not imply that a species will occur within the project area, but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed project occurs primarily in areas which have been previously developed and used for farming and pasture for a long period of time. Disturbance within these areas due to construction of the pipeline routes and well field is anticipated to have minimal effect on the existing environment. Impacts from the disposal of saline concentrate into Chiltipin Creek should be carefully monitored in order to minimize any impacts this may have on aquatic species. Although suitable habitat for some listed species may exist within the project areas, no impact is anticipated due to the abundance of similar habitat near the project area and the ability of most species to relocate to those areas if necessary. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetland impacts could occur along the pipeline and well field areas located near rivers, streams, or marshy areas. The wells, collection system within the well field, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable and a permit from the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

Cultural Resources

Impacts to National Register-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the well fields and pipeline routes.

A cultural resource survey of the well field and pipeline routes for each of the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

The pumping of groundwater from the Evangeline Aquifer could cause a slight reduction on baseflow in downstream reaches. However, no measurable impact on wildlife along the streams is anticipated from this project. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent.

5D.9.2.4 Engineering and Costing

Based on data collected and provided by Evangeline/Laguna LP, the key features identified and evaluated for planning and costing purposes for 2021 Region N Plan water management strategy are as follows:

- Wells: The well field consists of 13 wells (production constrained by MAG). At full project production, the wellfield consists of 18 wells including contingency. Well depth = 1,000 ft Pumping rate = 1,200 gallons per minute (gpm) each. Wells are phased based on MAG limitations, with full well field build-out after Year 2050 as described above.
- Raw groundwater quality of 800 mg/L TDS is expected, and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides.
- Although test well data shows water quality meets drinking water standards and could be delivered to an industrial customer untreated (Chapter 5D.8.2 includes evaluation of this option), pumped groundwater may also be conveyed to a new groundwater desalination plant located on property north of the City of Sinton which is part of the Evangeline/Laguna LP project and treated to a finished water goal of 200 mg/L TDS based on future industrial water quality needs.
- A purchase cost of raw water of $480.60 per ac-ft.
- Transmission and treatment plant costed according to full project build-out: 28,486 acft/yr (25 MGD). Pumped groundwater is limited based on MAG.
- Treatment plant assumes 800 mg/l TDS influent, 200 mg/l TDS effluent; plant treats 75% of raw groundwater (25% bypass) at 75% process efficiency.
- Brine concentrate disposal to Chiltipin Creek downstream of the City of Sinton's WWTP discharge location.
- Treated water yield: 19,898 ac-ft/yr (17.75 mgd) of treated groundwater under initial allowable ground production limits and have an ultimate yield of 22,788 ac-ft/yr (20.3 MGD) after 2050.
- Treated water delivery options:
    - Option 1 - New transmission line to San Patricio industries near San Patricio Municipal Water District (SPMWD) complex
    - Option 2 - Integrate into SPMWD Dressen line near pump station. Capacity upgrades needed to deliver full project supply.
    - Option 3 - Integrate in Mary Rhodes Pipeline downstream of SPMWD's 36-in Dressen take. Assuming SPMWD delivery rates in City contract and the City's

supplies from Lake Texana and Colorado, preliminary hydraulic calculations indicate that the existing MRP pipeline capacity is adequate to deliver this additional water to the O.N. Stevens WTP.

Overall, the project cost ranges from $155,431,000 to $190,416,000 depending on delivery option. Annual costs range from $34,707,000 to $37,675,000. At a yield of 19,898 ac-ft/yr, the unit cost of water ranges from $1,195 to $1,893 per ac-ft for the range of delivery options evaluated. Cost tables are presented in Table 5D.9.5 through Table 5D.9.8. A cost estimate summarizing updated unit cost with full utilization of Delivery Option 1 after 2050 when sufficient MAG is available is shown in Table 5D.9.6.

Table 5D.9.5. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Treated Groundwater Strategy-Region N Plan with MAG Limits (Delivery Option 1)

Item	Estimated Costs for Facilities
Primary Pump Station	$9,030,000
Brine Concentrate Pump Station (5.4 MGD)	$992,000
Transmission Pipeline (36 in dia., 20.5 mi treated; 1.5 mi brine concentrate)	$29,835,000
Well Fields (18 Wells *only 12 Operating*, Pumps, and Piping)	$35,051,000
Water Treatment Plant (21 MGD)	$56,990,000
Total Cost of Facilities	**$131,898,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$44,674,000
Environmental & Archaeology Studies and Mitigation	$1,041,000
Land Acquisition and Surveying (~80 acres)	$554,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$12,249,000
Total Cost of Project	**$190,416,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$13,398,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$649,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$251,000
Water Treatment Plant	$10,536,000
Pumping Energy Costs (11085191 kW-hr @ 0.08 $/kW-hr)	$887,000
Purchase of Raw Water (24,873 acft/yr @ 480.6 $/acft)	$11,954,000
Total Annual Cost	**$37,675,000**
Available Project Yield (acft/yr)	19,898
Annual Cost of Water ($ per acft)	$1,893
Annual Cost of Water After Debt Service ($ per acft)	$1,220
Annual Cost of Water ($ per 1,000 gallons)	$5.81
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.74

Note: One or more cost element has been calculated externally.
No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

Table 5D.9.6.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Evangeline/Laguna LP Treated Groundwater Strategy-
Up to Permitted Amount after 2050 when MAG is Available (Delivery Option 1)

Item	Estimated Costs for Facilities
Primary Pump Station	$9,030,000
Brine Concentrate Pump Station (5.4 MGD)	$992,000
Transmission Pipeline (36 in dia., 20.5 mi treated; 1.5 mi brine concentrate)	$29,835,000
Well Fields (18 Wells, Pumps, and Piping)	$35,051,000
Water Treatment Plant (21 MGD)	$56,990,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$44,674,000
Environmental & Archaeology Studies and Mitigation	$1,041,000
Land Acquisition and Surveying (~80 acres)	$554,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$12,249,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$13,398,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$649,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$251,000
Water Treatment Plant	$10,536,000
Pumping Energy Costs (15650915 kW-hr @ 0.08 $/kW-hr)	$1,252,000
Purchase of Raw Water (28,485 acft/yr @ 480.6 $/acft)	$13,690,000
Available Project Yield (acft/yr)	22,788
Annual Cost of Water ($ per acft)	$1,745
Annual Cost of Water After Debt Service ($ per acft)	$1,158
Annual Cost of Water ($ per 1,000 gallons)	$5.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.55

Note: One or more cost element has been calculated externally.
No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

Table 5D.9.7.
Cost Estimate Summary Water Supply Project Option,
September 2018 Prices,
Evangeline/Laguna LP Treated Groundwater Strategy - Region N Plan With MAG Limits (Option 2)

Item	Estimated Costs for Facilities
Primary Pump Station	$4,835,000
Brine Concentrate Pump Station (5.4 MGD)	$992,000
Transmission Pipeline (36 in dia., 4.75 mi treated; 1.5 mi brine concentrate)	$9,465,000
Well Fields (18 Wells *only 12 Operating*, Pumps, and Piping)	$35,051,000
Water Treatment Plant (21 MGD)	$56,990,000
Total Cost of Facilities	**$107,333,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$37,098,000
Environmental & Archaeology Studies and Mitigation	$660,000
Land Acquisition and Surveying (25 acres)	$344,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$10,000,000
Total Cost of Project	**$155,431,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$10,936,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$445,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$146,000
Water Treatment Plant	$10,536,000
Pumping Energy Costs (8622683 kW-hr @ 0.08 $/kW-hr)	$690,000
Purchase of Water (24,873 acft/yr @ 480.6 $/acft)	$11,954,000
Total Annual Cost	**$34,707,000**
Available Project Yield (acft/yr)	19,898
Annual Cost of Water ($ per acft)	$1,744
Annual Cost of Water After Debt Service ($ per acft)	$1,195
Annual Cost of Water ($ per 1,000 gallons)	$5.35
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.67

Note: One or more cost element has been calculated externally.
No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

Table 5D.9.8. Cost Estimate Summary Water Supply Project Option, September 2018 Prices, Evangeline/Laguna LP Treated Groundwater Strategy - Region N Plan With MAG Limits (Option 3)

Item	Estimated Costs for Facilities
Primary Pump Station	$5,803,000
Brine Concentrate Pump Station (5.4 MGD)	$992,000
Transmission Pipeline (36 in dia., 5 mi treated; 1.5 mi brine concentrate)	$9,977,000
Well Fields (Wells, Pumps, and Piping)	$35,051,000
Water Treatment Plant (21 MGD)	$56,990,000
Total Cost of Facilities	**$108,813,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$37,591,000
Environmental & Archaeology Studies and Mitigation	$667,000
Land Acquisition and Surveying (26 acres)	$348,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$10,136,000
Total Cost of Project	**$157,550,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$11,085,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$450,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$170,000
Water Treatment Plant	$10,536,000
Pumping Energy Costs (9456774 kW-hr @ 0.08 $/kW-hr)	$757,000
MRP Energy and Power Capacity Compensation	$207,000
Purchase of Water (24,873 acft/yr @ 480.6 $/acft)	$11,954,000
Total Annual Cost	**$35,159,000**
Available Project Yield (acft/yr)	19,898
Annual Cost of Water ($ per acft)	$1,767
Annual Cost of Water After Debt Service ($ per acft)	$1,210
Annual Cost of Water ($ per 1,000 gallons)	$5.42
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.71

Note: One or more cost element has been calculated externally.
No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

5D.9.2.5 Implementation Issues

The groundwater supply analyses considered for this water management strategy were based on MAGs adopted by local GCD and GMAs according to TWDB guidance for regional water planning. For future planning efforts, new MAGs provided by GCDs and GMAs located in the Coastal Bend Region need to be considered when determining available groundwater supplies.

Implementation of a Groundwater Desalination Project includes the following issues:

- Permitting desalination concentrate discharge to Chiltipin Creek, Copano and Oso Bays for some options;
- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Purchase or lease of property for well field, and coordination with landowners;
- Skilled operators of desalination water treatment plants;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- General Land Office Easement for use of State-owned lands, if any;
- Cultural resources investigations in accordance with the Texas Historical Commission and the Texas Antiquities Code;
- Texas Parks and Wildlife Department Sand, Gravel, and Marl permit; and
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

5D.9.2.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.9.9.

Table 5D.9.9.
Evaluation Summary of the Evangeline/Laguna LP Groundwater Desalination (Treated Water) Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield limited to 19,898 acft/yr through 2050 based on MAG limiting pumping to 24,873 ac-ft/yr.
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate to high cost; between $1,195 to $1,893 per ac-ft
b. Environmental factors:	
1. Instream flows	1. Moderate impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None to low, with discharge location downstream of Sinton WWTP discharge. Greatest impact is during low-flow conditions.
3. Wildlife habitat	3. Disposal of concentrated brine with bay option may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b,d. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be addressed prior to project implementation. 7c. None or low impact. 7e-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Potential impacts to agricultural or seasonal water users along Chiltipin Creek associated with brine discharge. Discharge is downstream of Sinton WWTP discharge to reduce environmental impacts. Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Reverse osmosis treatment costs modeled after bid and manufacturers' budgets, but not constructed
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

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5D.10

Seawater Desalination (N-10)

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5D.10 Seawater Desalination (N-10)

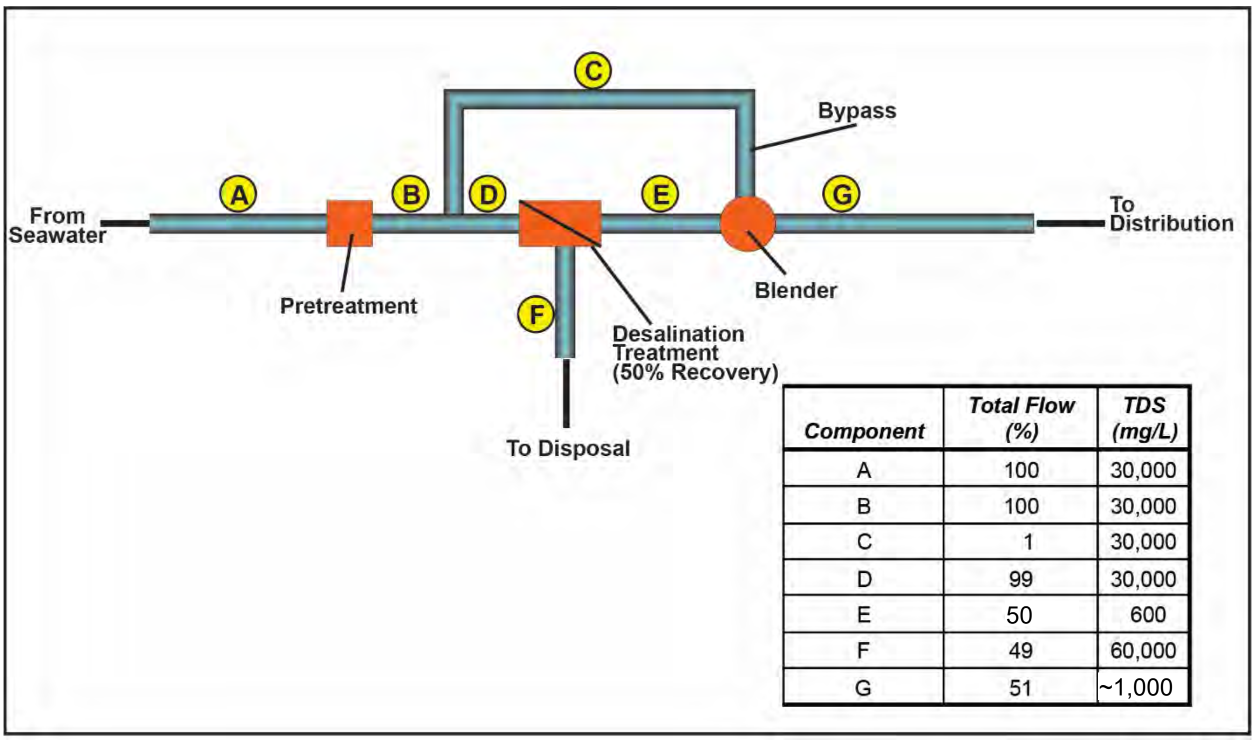
5D.10.1 Seawater Desalination Background

Seawater desalination is a process whereby seawater is treated to reduce total dissolved solids, salts, and minerals to make suitable for human consumption and/or high quality industrial/manufacturing purposes. Seawater near Corpus Christi Bay, where plants are being considered, is estimated to have total dissolved solids (TDS) content of between 30,000 and 50,000 parts per million.

Commercially available processes that are commonly used to desalt seawater to produce potable water are:

- Distillation (thermal) Processes; and
- Membrane (non-thermal) Processes.

Figure 5D.10.1 shows a process diagram for a typical seawater desalination treatment plant, the percent of water flowing through each component of the system, and the concentration of the TDS. This diagram is intended to serve as an example, recognizing that details and recovery percentages for specific seawater desalination plants may vary.



Component	*Total Flow (%)*	*TDS (mg/L)*
A	100	30,000
B	100	30,000
C	1	30,000
D	99	30,000
E	50	600
F	49	60,000
G	51	~1,000

Figure 5D.10.1.
Flow Diagram for a Typical Seawater Desalination Water Treatment Plant

The following section describes distillation and membrane processes and discusses a number of issues that should be considered before selecting a process for desalination of seawater. Coastal seawater desalination projects are either in operation or under construction in Florida and California, but there are no seawater desalination plants operating in Texas.[1]

5D.10.2 Distillation (Thermal) Processes

Distillation processes produce purified water by vaporizing a portion of the saline feedstock to form steam. Since the salts dissolved in the feedstock are nonvolatile, they remain unvaporized and the steam formed is captured as a pure condensate. Distillation processes are normally very energy-intensive, expensive, and are generally used for large-scale desalination of seawater. Heat is usually supplied by steam produced by boilers or from a turbine power cycle used for electric power generation. Distillation plants are commonly dual-purpose facilities that produce purified water and electricity. According to a recent study by the City of Corpus Christi, geothermal energy is better suited to thermal desalination rather than reverse osmosis membrane processes.[2]

In general, for a specific plant capacity, the equipment in distillation plants tends to be much larger than membrane desalination equipment. However, distillation plants do not have the stringent feedwater quality requirements of membrane plants. Due to the relatively high temperatures required to evaporate water, distillation plants have high energy requirements, making energy a large factor in their overall water cost. Their high operating temperatures can result in scaling (precipitation of minerals from the feedwater), which reduces the efficiency of the evaporator processes. Once an evaporator system is constructed, the size of the exchange area and the operating profile are fixed, leaving energy transfer as a function of only the heat transfer coefficient. Therefore, any scale that forms on heat exchanger surfaces reduces heat transfer coefficients. Under normal circumstances, scale can be controlled by chemical inhibitors, which inhibit but do not eliminate scale, and by operating at temperatures of less than 200 degrees Fahrenheit.

Distillation product water recoveries normally range from 15 to 45 percent, depending on the process. The product water from these processes is nearly mineral-free, with very low total dissolved solids (TDS) (less than 25 mg/L). However, this product water is extremely aggressive and is too corrosive to meet the Safe Drinking Water Act corrosivity standards without post-treatment. Product water can be stabilized by chemical treatment or by blending with other potable water.

The three main distillation processes in use today are Multistage Flash Evaporation (MSF), Multiple Effect Distillation (MED), and Vapor Compression (VC). All three of these processes utilize an evaporator vessel that vaporizes and condenses the feedstock. The three processes differ in the design of the heat exchangers in the vessels and in the method of heat introduction

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[1] City of Corpus Christi website, "Corpus Christi Desalination Demonstration Project", June 2014. http://www.cctexas.com/Assets/Departments/Water/Files/DesalFactSheet.pdf
[2] City of Corpus Christi, Variable Salinity Desalination Demonstration Project "Technical Memorandum No. 1- Desalination Technology Research Project No. E13063", September 2014.

into the process. Since there are no distillation processes in Texas that can be shown as comparable installations, distillation will not be considered here. However, there are membrane desalination operations in Texas, so the following discussion and analyses are based upon information from the use of membrane technology for desalination.

5D.10.2.1 Membrane (Non-Thermal) Processes

The two types of membrane processes use either pressure — as in reverse osmosis (RO) — or electrical charge — as in electrodialysis reversal (EDR) — to reduce the mineral content of water. Both processes use semi-permeable membranes that allow selected ions to pass-through while other ions are blocked. EDR uses direct electrical current applied across a vessel to attract the dissolved salt ions to their opposite electrical charges. EDR can desalinate brackish water with TDS up to several thousand milligrams per liter, but energy requirements make it economically uncompetitive for seawater, which contains approximately 35,000 mg/L TDS. As a result, only RO is used for seawater desalination.

RO utilizes a semi-permeable membrane that limits the passage of salts from the saltwater side to the freshwater side of the membrane. Electric motor-driven pumps or steam turbines (in dual-purpose installations) provide the 800 to 1,200 pounds per square inch (psi) pressure to overcome the osmotic pressure and drive the freshwater through the membrane, leaving a waste stream of brine/concentrate. The basic components of an RO plant include pre-treatment, high-pressure pumps, membrane assemblies, and post-treatment. Pretreatment is essential because feedwater must pass through very narrow membrane passages during the process and suspended materials, biological growth, and some minerals can foul the membrane. As a result, virtually all suspended solids must be removed and the feedwater must be pre-treated so precipitation of minerals or growth of microorganisms does not occur on the membranes. This is normally accomplished by using various levels of filtration and the addition of various chemical additives and inhibitors. Post-treatment of product water is usually required prior to distribution to reduce its corrosivity and to improve its aesthetic qualities. Specific treatment is dependent on product water composition.

A "single-pass/stage" seawater RO plant will produce water with a TDS of 300 to 500 mg/L, most of which is sodium and chloride. The product water will be corrosive, but this may be acceptable, if a source of blending water is available. If not, and if post-treatment is required, the various post-treatment additives may cause the product water to exceed the desired TDS levels. In such cases, or when better water quality is desired, a "two-pass/stage" RO system is used to produce water typically in the 200 mg/L TDS range. In a two-pass RO system, the concentrate water from the first RO pass/stage is further desalted in a second RO pass/stage, and the product water from the second pass is blended with product water from the first pass.

Recovery rates up to 45 percent are common for a two-pass/stage seawater RO facility. RO plants, which comprise about 47 percent of the world's desalting capacity, range from a few gallons per day to 35 mgd. The largest RO seawater plant in the United States is the 25 mgd plant in Tampa Bay, Florida. The current domestic and worldwide trend seems to be for the adoption of RO when a single purpose seawater desalting plant is to be constructed. RO membranes have been improved significantly over the past two decades (i.e. the membranes have been improved with respect to efficiency, longer life, and lower prices). Municipal use desalination plants in Texas that use lake water, river, or groundwater are shown in Table 5D.10.1. The plant capacities range from 0.1 mgd (Homestead MUD-El Paso) to 10 mgd (Lake Granbury).

Table 5D.10.1.
Municipal Use Desalt Plants in Texas (greater than 25,000 gpd as of April 2015)

Location	County	Source	Raw Water TDS (mg/L), estimate	Target TDS for Finished Water (mg/L)	Total Capacity (mgd)	Desalt Capacity (mgd)	Membrane Type[1]	Membrane Recovery (%)
Big Bend Motor Inn	Brewster	Groundwater	1694	300	0.057	0.057	RO	75
Abilene, City of	Taylor	Surface Water	1,500	500	7.95	3	RO	65-78
Bardwell, City of	Ellis	Groundwater	No Data	400	0.252	0.036	RO	60
Bayside, City of	Refugio	Groundwater	2500	350	0.045	-	RO	No Data
Beckville, City of	Panola	Groundwater	1200	100	0.216	0.216	RO	75
Brady, City of	McCulloch	Surface Water	1200-1600	No Data	3	1.5	RO	75
Clarksville City, City of	Gregg	Groundwater	No Data	No Data	0.288	0.288	RO	75
Evant, City of	Coryell	Groundwater	1100	800	0.1	0.08	RO	80
Ft. Stockton, City of	Pecos	Groundwater	1500	1000	6.5	6.5	RO	80
Granbury, City of (IDLE)	Hood	Surface Water	No Data	No Data	0.462	0.35	RO	No Data
Hubbard, City of	Hill	Groundwater	2793	No Data	0.648	0.432	RO	62
Kenedy, City of	Karnes	Groundwater	1500	No Data	2.86	0.72	RO	67
Laredo, City of	Webb	Groundwater	2112	250	0.1	0.1008	RO	76
Los Ybanez, City of (IDLE)	Dawson	Groundwater	No Data	No Data	-	-	RO	No Data
Robinson, City of	McLennan	Surface Water	750	50	2.3	1.6	RO	75
Seadrift, City of	Calhoun	Groundwater	2200	400	0.61	0.524	RO	70
Seymour, City of	Baylor	Groundwater	800	400	3	3	RO	81
Sherman, City of	Grayson	Surface Water	No Data	440	11	7.5	EDR	85
Tatum, City of	Rusk	Surface Water	1200	320	0.324	0.288	RO	75
Cypress WTP	Wichita	Surface Water	3500	200	10	-	RO	71
Dell City	Hudspeth	Groundwater	1466	435	0.1	0.1	EDR	75
DS Waters of America, LP	Waller	Groundwater	470	36	0.09	-	RO	75
Esperanza Fresh Water Supply	Hudspeth	Groundwater	No Data	No Data	0.023	-	RO	No Data
Fort Hancock RO Plant 1	Hudspeth	Groundwater	No Data	No Data	0.43	0.43	RO	78
Holiday Beach WSC	Aransas	Groundwater	2000	450	0.15	-	RO	70
Horizon Regional MUD RO Plant	El Paso	Groundwater	No Data	80	6	3.3	RO	75
K.B. Hutchison Desalination Plant	El Paso	Groundwater	2000-3000	450-500	27.5	15	RO	82.5
Lake Granbury	Hood	Surface Water	No Data	35	12.5	7.5	RO	85

Location	County	Source	Raw Water TDS (mg/L), estimate	Target TDS for Finished Water (mg/L)	Total Capacity (mgd)	Desalt Capacity (mgd)	Membrane Type[1]	Membrane Recovery (%)
Longhorn Ranch Motel	Brewster	Groundwater	3500	No Data	0.023	0.023	RO	No Data
Midland Country Club	Midland	Groundwater	3840	200	0.023	0.11	RO	80
North Alamo WSC (Doolittle)	Hidalgo	Groundwater	2500	500	3.5	3	RO	No Data
North Alamo WSC (Lasara)	Willacy	Groundwater	No Data	500	1.2	1	RO	No Data
North Alamo WSC (Owassa)	Hidalgo	Groundwater	2000	500	2	1.5	RO	No Data
North Cameron/ Hidalgo WA	Cameron	Groundwater	3500	200	2.5	2	RO	75
Oak Trail Shores	Hood	Surface Water	No Data	No Data	1.584	-	RO	No Data
Possum Kingdom WSC	Palo Pinto	Surface Water	2400	50-100	1	-	RO	75
River Oaks Ranch	Hays	Groundwater	1500	300	0.1152	0.1152	RO	70
Southmost Regional Water Authority	Cameron	Groundwater	3500	500	7.5	6	RO	75
Sportsmans World MUD	Palo Pinto	Surface Water	No Data	300	0.083	0.083	RO	50
Study Butte Terlingua Water System	Brewster	Groundwater	1425	200	0.14	0.144	RO	75
The Cliffs	Palo Pinto	Surface Water	No Data	400	0.381	0.381	RO	80
Valley MUD #2	Cameron	Groundwater	3500	400	1	0.5	RO	75
Veolia WTP (IDLE)	Jefferson	Surface Water	No Data	No Data	0.245	0.066	RO	80
Victoria Road RO Plant	Hidalgo	Groundwater	4000	150	2.25	2	RO	75
Water Runner Inc.	Midland	Groundwater	790	No Data	0.028	2.16	RO	95
Windermere Water System (IDLE)	Travis	Groundwater	900	No Data	2.88	1	RO	No Data

Source: TWDB Desalination Plant Database, 2010

[1] RO = Reverse Osmosis EDR = Electrodialysis Reversal

5D.10.2.2 Examples of Relevant Existing Desalt Projects

Seadrift, TX: In 1996, Seadrift (retail population 1,890) was dependent on the Gulf Coast Aquifer for its water supply. TDS and chlorides had reached unacceptable levels of 1,592 mg/L and 844 mg/L, respectively. These values exceeded the primary drinking water standard for TDS (1,000 mg/L) and the secondary drinking water standard for chlorides (300 mg/L). Since the community was not located near an adequate quantity of freshwater or a wholesaler of drinking water, the decision was made to install RO to treat this slightly brackish groundwater. The city installed pressure filters, two RO units, antiscalant chemical feed equipment, and a chlorinator. The capital cost for the system was $1.2 million and the annual operation and maintenance (O&M) cost is $56,000, resulting in a total debt service plus O&M cost of about $0.88 per 1,000 gallons treated by RO. The capital cost included the cost of facilities in addition to the RO units and their appurtenant equipment. Product water from the RO units is blended with groundwater to meet an acceptable quality level. About 60 percent of the total is from the desalt units.

Tampa, FL: The water utility, Tampa Bay Water, selected a 30-year design, build, operate, and own (DBOO) proposal to construct a nominal 25 mgd seawater desalt plant. The plant will use RO as the desalt process. The proposal included total capitalization and operations costs for producing high quality drinking water (chlorides less than 100 mg/L). The total cost to Tampa Bay Water in the original proposal was to be $2.08 per 1,000 gallons on a 30-year average, with first year cost being $1.71 per 1,000 gallons. However, subsequent issues with the original design including significant problems in obtaining adequate pretreatment have increased the projected total cost to Tampa Bay Water by $0.72 per 1,000 gallons for a total projected cost of $2.80 per 1,000 gallons on a 30-year average.[3] The results of Tampa Bay's competition has attracted international interest in the current cost profile of desalting seawater for drinking water supply, since these costs are only about one-half the levels experienced in previous desalination projects.

Tampa Bay Water selected the winning proposal from four DBOO proposals submitted, which ranged from $2.08 to $2.53 per 1,000 gallons. The factors listed below may be all or partially responsible for these seemingly low costs:

- Salinity at the Tampa Bay sites ranges from 25,000 to 30,000 mg/L, lower than the more common 35,000 mg/L for seawater. RO cost is sensitive to salinity.
- The power cost, which is interruptible, is below $0.04 per kilowatt-hour (kWh).
- Construction cost savings through using existing power plant canals for intake and concentrate discharge.
- Economy of scale at 25 mgd.
- Amortizing over 30 years.
- Use of tax-exempt bonds for financing.

The Tampa bids contrast with another current large-scale desalination project in which distillation is proposed. The current desalt project of the Singapore Public Utility Board, which proposes a 36 mgd multi-stage flash distillation plant, will cost an estimated $5.76 per 1,000 gallons for the first year operation.[4]

Carlsbad Desalination Facility: This 54 MGD desalination plant is located in California and designed by Poseidon with 10 miles of 54 inch pipeline serving San Diego County. It is the largest desalination plan in the Americas. The main technology used for desalination is reverse osmosis. The main delivery method is Design-Build-Finance-Own-Operate-Maintain and Transfer. The total capital cost for the project was around $922 million, with financing closed in 2012. The project became operational in December 2015 and was delivered on time and on budget. The total water produced to date is greater than 51 billion gallons. The estimated cost is around $7.82 per thousand gallons, which includes the cost to pump water through the 10 mile pipeline including a 1,000 ft elevation increase.

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[3] Associated Press, "Tampa Bay Water to Hire Group to Fix Desalination Plant," September 21, 2004.
[4] Desalination & Water Reuse Quarterly, vol. 7/4, Feb/Mar 1998.

5D.10.3 Environmental Issues

House Bill (HB) 2031, passed by the 84th Legislature, requires consultation with TWDB and the GLO regarding siting of marine seawater desalination intakes and discharges to minimize ecological impacts. This legislation created new Texas Water Code (TWC) Chapter 18 addressing marine seawater desalination projects. TWC §18.003 establishes the requirements for obtaining a permit to divert the state's seawater and to discharge brine effluent from desalination projects into the Gulf of Mexico. This legislation applies to desalination plants sited outside the Texas coastal barrier islands.

In Region N, five proposed desalination plant options are being considered by different entities, including the City of Corpus Christi, the Port of Corpus Christi Authority, and Poseidon/City of Ingleside, as shown in Figure 5D.10.2. Site specific environmental issues are discussed in the following sections (Sections 5D.10 through 5D.12). This section discusses more general environmental issues associated with seawater desalination plants in the Coastal Bend area.

Figure 5D.10.2.
Locations for Proposed Seawater Desalination Plants in Region N

Estuaries and bays serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from the abundance of terrigenous nutrient input, shallow water, and the ability of a few marine species to exploit environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the construction of a desalination plant in the vicinity of Nueces Bay and/or Corpus Christi Bay will be sensitive to the siting of the plant and its appurtenances. Environmental analyses including impingement and entrainment will need to be considered as part of the intake evaluation.

The Texas Parks and Wildlife Department (TPWD) and the General Land Office (GLO) conducted a joint agency study[5], required by HB 2031, on marine seawater desalination plants. The study included general recommendations for diversion intake systems to reduce environmental impacts to marine organisms. While the projects proposed in the following sections are located bayside of the coastal barrier islands and are considered seawater desalination plants, some of the recommendations from the study may be applicable. The recommendations in the study for intake structures included:

- Keeping the flow-through velocity of seawater at the intake structure below 0.5 feet per second;
- Design intake structures to adjust or adaptively manage with varying flows and water quality;
- Design intake structures and reduce velocity so marine organisms can escape the intake; and
- Use exclusion devices, such as screens or booms, to exclude organisms from the intake.
- If possible and feasible, the study suggested drawing water down through a sandy bottom to below ground piping which would prevent impingement of marine organisms and entrainment of other organisms on the intake screen.

Concentrated brine effluent is produced during the desalination process. Releasing brine concentrate could potentially affect organisms that are dependent upon a specific range of temperature and salinity. Changes to the ratio and type of salt discharges can cause osmotic imbalances and toxicity. The joint TPWD/GLO study on marine seawater desalination also summarized recommendations on siting discharge locations, from their study and published literature. Site specific studies on the receiving waters and brine discharges should be conducted during project planning and include salinity, types of salts, circulation at the discharge site, other contaminants from the process, maintenance, and pipes that may be discharged to the receiving water. These studies should be conducted to find ways to minimize any potential toxicity and impacts to receiving water chemistry and biota.[6] Salinity can affect the density of seawater with higher salinity correlating to denser water thereby potentially affecting water movement in the area. The City of Corpus Christi and Port of Corpus Christi Authority (PCCA) have suggested the use of diffusers at the discharge point, or another mechanism, to

[5] Texas Parks and Wildlife Department and Texas General Land Office, 2018. Marine Seawater Desalination Diversion and Discharge Zones Study. Accessed online https://tpwd.texas.gov/publications/pwdpubs/media/hb2031dz.pdf?d=462414.3799 December 26, 2019.

mix brine discharge effluent with the seawater to reduce these types of impacts[6]. The Gulf of Mexico coastal seawater typically has a concentration of approximately 35 parts sea salt per thousand parts water by weight, where freshwater is near zero. Salinity variations in estuary and bay areas are typically in response to river inflow, evaporation, and mixing by wind and ocean tides.[7]

The proposed projects are located within the Gulf Coast Prairies and Marshes physiographic region of Texas and within the Tamaulipan biotic province.[8] According to general vegetation data for the state of Texas, several vegetation types occur within the vicinity of the proposed projects, including urban, crops, live oak woods/parks, and marsh barrier island.[9] Vegetation impacts include clearing areas for the desalination plants and installation of pipelines.

According to Information for Planning and Consultation (IPaC), provided by the U.S. Fish & Wildlife Service (USFWS) on December 18, 2019, 16 federally-listed threatened or endangered species have the possibility of being in the project area (see Table 5D.10.2). Critical habitat for the threatened Piping Plover (Charadrius melodus) is located on San Jose Island and Mustang Island, within the two miles of Harbor Island and the proposed Port of Corpus Christi Authority (Port) Harbor Island desalination site.[10]

Table 5D.10.2 lists both state and federally listed endangered or threatened species along with species of concern that may occur in Region N, including Nueces and San Patricio counties. This information comes from the county lists of rare species published online by the TPWD. Inclusion in this table does not mean that a species will occur within the project area, but only acknowledges the potential for its occurrence in the project area county. Because the project will use seawater, no impacts to existing stream flows or stream habitats would be anticipated. Positive impacts to river and stream segments may occur as utilizing treated seawater may reduce or eliminate the water needs from freshwater surface sources. Potential impacts to listed species within the project area could occur due to disturbance associated with intake and discharge structures during operation of the facility. However, proper siting and studies conducted prior to implementation will minimize these impacts.

Impacts to existing habitat resulting from the construction of the desalination plants and their associated pipelines, pump stations and water treatment facilities would be expected. Destruction of potential habitat can be avoided by utilizing previously disturbed areas. Site specific habitat surveys should be conducted prior to project construction to determine whether populations of potential habitats used by listed species occur in the area to be affected.

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[6] City of Corpus Christi Seawater Desalination Project (https://www.cctexas.com/desal) Accessed December 27, 2019.
[7] Amec Foster Wheeler, 2017. Process Design Basis and Narrative Port of Corpus Christi Authority Industrial Seawater Desalination Harbor Island. December 2017.
[8] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.
[9] McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.
[10] USFWS, 2019. Information for Planning and Consultation (IPaC) resource list. December 18, 2019.

Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Table 5D.10.2.
Federally-Listed Threatened or Endangered Species in the Vicinity of Proposed Desalination Projects in the Coastal Bend Region

Common Name	Scientific Name	Federal Status	Habitat Requirements
Gulf Coast jaguarundi	*Herpailurus (=Felis) yagouaroundi cacomitli*	LE	Dense thorny shrublands.
Ocelot	*Leopardus (=Felis) pardalis*	LE	Restricted to mesquite-thorn scrub and live-oak mottes; avoids open areas.
West Indian manatee	*Trichechus manatus*	LT	Marine, brackish, and freshwater systems in coastal and riverine areas.
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*	LE	Coastal prairie that include grasses such as little bluestem, big bluestem, Indiangrass, and switchgrass.
Least Tern	*Sterna antillarum*	LE	Bare or sparsely vegetated sand, shell and gravel beaches, sandbars, islands, and salt flats.
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	LE	Open country, especially savanna and open woodland, and sometimes in very barren areas.
Piping Plover	*Charadrius melodus*	LT	Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore idlands. Also spoil islands in the Intracoastal Waterway.
Red Knot	*Calidris canutus rufa*	LT	Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.
Whooping Crane	*Grus americana*	LE	Small ponds, marshes and flooded grain fields for both roosting and foraging.
Green sea turtle	*Chelonia mydas*	LT	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches.
Hawksbill sea turtle	*Eretmochelys imbricata*	LE	Gulf and bay system, warm shallow waters especially in rocky marine environments such as coral reefs and jetties. Juveniles found in floating mats of sea plants.
Kemp's Ridley sea turtle	*Lepidochelys kempii*	LE	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico.
Leatherback sea turtle	*Dermochelys coriacea*	LE	Gulf and bay systems, and widest ranging open water reptile.
Loggerhead sea turtle	*Caretta caretta*	LT	Gulf and bay system primarily for juveniles, adults are most pelagic of sea turtles.
Slender rush-pea	*Hoffmannseggia tenella*	LE	Coastal prairie grasslands on level uplands and on gentle slopes along drainages.
South Texas ambrosia	*Ambrosia cheiranthifolia*	LE	Grasslands and mesquite-dominated shrublands on various soils. Mostly over the Beaumont Formation on the Coastal Plain.

Source: TPWD, 2019. Annotated County Lists of Rare Species (Nueces and San Patricio Counties). Updated July 17, 2019.

LE Federally listed endangered   LT Federally listed threatened

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Potential indirect environmental effects include air and greenhouse gas emissions associated with energy usage. These effects could be minimized by incorporating the use of renewable energy sources.

Cultural resource surveys of the plant sites and pipeline routes will need to be performed consistent with requirements of the Texas Antiquities Commission. Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by surface infrastructure, changes in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

5D.10.4 Implementation Issues

Permitting of this seawater desalination facilities will require extensive coordination with applicable regulatory entities, including TCEQ, GLO, and others listed above. Permitting and construction of the intake and concentrate pipeline will be major project components.

The installation and operation of a seawater desalination water treatment plant will likely have to address the following issues.

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and constructing concentrate pipeline through seagrass beds and barrier island;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permits;
- Confirming that blending desalted seawater with other water sources in the municipal demand distribution system can be successfully accomplished;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

5D.10.5 City of Corpus Christi Seawater Desalination- Inner Harbor and La Quinta Channel Projects

5D.10.5.1 Description of Strategy

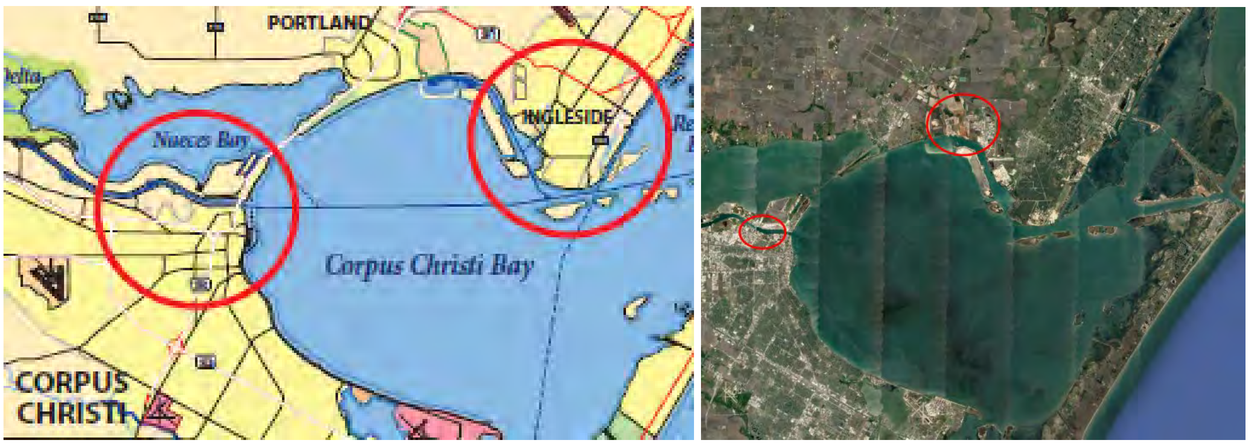
Desalting seawater from the Gulf of Mexico is a potential source of freshwater supplies for municipal and industrial uses. In August 2004, the City of Corpus Christi (City) conducted a feasibility study[11] funded by the TWDB of a large-scale seawater desalination facility in the Region N area. For the 2006 and 2011 Coastal Bend Regional Water Plans, a large-scale 25 to 100 mgd seawater desalination facility co-sited with the Barney M. Davis Power Station in Corpus Christi near Laguna Madre, Oso Bay, and Corpus Christi Bay was considered. Favorable factors for the Barney Davis power station location include: use of cooling plant effluent for diluting concentrate, ability to use the existing seawater intake infrastructure at the power plant, and close proximity to the water distribution system. The desalination concentrate was considered to be piped out to the open Gulf of Mexico to be discharged in waters over 30 feet deep. The 2011 Coastal Bend Plan estimated the cost of a 25 mgd seawater desalination facility at Barney M. Davis Power Station with 5-mile pipeline delivery to proposed distribution center on the south side of town at $1,696 per ac-ft (or $5.21 per 1,000 gallons) based on September 2008 dollars. Blending with brackish groundwater, previously evaluated in the 2006 Plan, was eliminated from further consideration based on the lack of availability of groundwater at suitable quality (summarized in Chapter 11). The seawater desalination facility co-sited with Barney M. Davis Power Station was included as an alternate strategy in the 2011 Coastal Bend Regional Water Plan at the 25 mgd size, which was subsequently updated through amendment in August 2014 to be listed as a recommended strategy in the 2011 Coastal Bend Plan to meet needs beginning in 2020.

The City, as a wholesale water provider, continues to evaluate seawater desalination options, including variable desalination programs and combinations with brackish groundwater resources to address future industrial development and anticipated population growth associated with new industry and Eagle Ford Shale production. In April 2014, the Corpus Christi City Council voted to accept a federal, U.S. Bureau of Reclamation grant and transfer funds from the City's Raw Water Supply Development Fund for a City of Corpus Christi Desalination Program Pilot Study. In July 2014, Corpus Christi City Council considered and subsequently adopted a resolution to the 84th Texas Legislature to appropriate funding for FY 16-17 biennium and partnering with local sponsors to implement desalination projects.

The City conducted a $3 million demonstration program with support from the U.S. Bureau of Reclamation to design, construct, and operate a demonstration desalination plant for industrial and drinking water purposes. The objectives of the program are to evaluate the feasibility of seawater desalination and develop cost estimates, to test emerging technologies, and to identify and assess site options and requirements for a full-scale facility.[12] With the results of the study,

[11] City of Corpus Christi, Draft Report "Large Scale Demonstration Desalination Feasibility Study," August 2004.
[12] City of Corpus Christi website, "Corpus Christi Desalination Demonstration Project", June 2014. http://www.cctexas.com/Assets/Departments/Water/Files/DesalFactSheet.pdf

the City will consider moving forward with a full-scale desalination project. During preliminary studies, the Barney M. Davis Power Station option was removed from further consideration due to a lack of interest by the power station to participate, as well as the location not being favorable with respect to anticipated industrial and municipal growth areas.[13] As of November 2019, two potential sites are being considered by the City of Corpus Christi to provide additional supplies of 10 mgd for Nueces County industries and municipal customers and 20 mgd for San Patricio County: Inner Harbor and La Quinta Channel. These locations are shown in Figure 5D.10.3, with the aerial photograph showing the most current location.



Source: Corpus Christi Desalination Demonstration Project Fact Sheet, June 2014 (http://www.cctexas.com/Assets/Departments/Water/Files/DesalFactSheet.pdf) and City of Corpus Christi, email October 2019

Figure 5D.10.3.
Proposed Location for Seawater Desalination Program

The Inner Harbor Desalination site in Nueces County could scale up from 10 to 30 MGD and La Quinta Channel Desalination site in San Patricio County could scale up from 20 to 40 MGD. The plants will likely expand to ultimate capacity in 30 years or more (2070+), but flexibility will be left for significant demand growth in the region. The treatment efficiency of the desalination plant is estimated to be 45- 50 percent. The finished water quality is targeted to be approximately 500 mg/L. The Inner Harbor Plant will treat all of its product water to potable standards and send it through the City of Corpus Christi distribution system. The La Quinta Channel Plant will treat the product water to potable water standards and deliver it to SPMWD. The SPMWD will deliver this water to industrial customers, but they may adjust water quality to meet the needs of different customers.

[13] City of Corpus Christi staff, February 2015.

5D.10.5.2 Available Yield- Inner Harbor

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The City of Corpus Christi and port industries are currently considering finished desalination supplies of 10 mgd (11,201 ac-ft/yr) to 30 MGD (33,604 ac-ft/yr) at the Inner Harbor facility.

5D.10.5.3 Engineering and Costing- Inner Harbor

Based on information provided by City staff and its consultant, the following costs were identified for the Inner Harbor seawater desalination project as shown in Table 5D.10.3 and Table 5D.10.4:

- Total estimated construction costs for a 10 mgd Inner Harbor facility $237 million.
- Total estimated construction costs for a 30 mgd Inner Harbor facility $563 million.
- Lifecycle water production costs, at the fence, are estimate to be $9.87 per 1,000 gallons with debt service for a plant located at the 10 MGD Inner Harbor facility.
- Lifecycle water production costs, at the fence, are estimate to be $7.84 per 1,000 gallons with debt service for a plant located at the 30 MGD Inner Harbor facility.

Details regarding intake, desalination process, concentrate disposal outfall, and site-specific environmental impacts for transmission and delivery is unavailable at this time. A 3,500 ft raw water pipeline, 2,300 ft concentrate discharge pipeline, and 500 ft product water delivery line are included in the cost estimate, based on information provided by Freese and Nichols.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the Unified Costing Model tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around $36,042,000 to $85,875,000 for the 10 MGD and 30 MGD plants. This results in a unit cost of water of $3,218 to $2,555 per ac-ft after debt service for Inner Harbor sites with plant size ranging from 10-30 MGD. Private industry partnerships and funding structures may be considered to help reduce costs and minimize treatment plant operation and maintenance risks assumed by City operators, which may account for costing differences as compared to information shown in Table 5D.10.3 and Table 5D.10.4. The information was developed based on capital costs, project costs, and annual water productions costs provided by Freese and Nichols, updated using the UCM and is relevant for desalination distribution near the facility. Delivery costs to specific industries or municipal distribution system are not included.

Table 5D.10.3. Cost Estimate Summary, City of Corpus Christi- Inner Harbor 10 mgd Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline (raw water piping)	$25,000,000
Storage Tanks (and Delivery)	$11,000,000
Water Treatment Plant (10 MGD)	$126,855,000
Total Cost of Facilities	**$162,855,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$55,749,000
Land Acquisition and Surveying (12 acres)	$50,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$18,039,000
Total Cost of Project	**$236,693,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$16,654,000
Water Treatment Plant	$19,028,000
Total Annual Cost	**$36,042,000**
Available Project Yield (acft/yr)	11,201
Annual Cost of Water ($ per acft)	$3,218
Annual Cost of Water After Debt Service ($ per acft)	$1,731
Annual Cost of Water ($ per 1,000 gallons)	$9.87
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$5.31

Note: Costs based on information provided by the City of Corpus Christi. The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

Table 5D.10.4. Cost Estimate Summary, City of Corpus Christi- Inner Harbor 30 mgd Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline (raw water piping; brine concentrate disposal x 3)	$51,000,000
Storage Tanks (and Delivery) x 3	$33,000,000
Water Treatment Plant (30 MGD)	$302,911,000
Total Cost of Facilities	**$386,911,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$132,869,000
Land Acquisition and Surveying (26 acres)	$108,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$42,891,000
Total Cost of Project	**$562,779,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$39,598,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$840,000
Water Treatment Plant	$45,437,000
Total Annual Cost	**$85,875,000**
Available Project Yield (acft/yr)	33,604
Annual Cost of Water ($ per acft)	$2,555
Annual Cost of Water After Debt Service ($ per acft)	$1,377
Annual Cost of Water ($ per 1,000 gallons)	$7.84
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$4.23

Note: Costs based on information provided by the City of Corpus Christi. The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

5D.10.5.4 Available Yield- La Quinta

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The City of Corpus Christi and port industries are currently considering finished desalination supplies of 20 mgd (22,403 ac-ft/yr) to 40 mgd (44,806 ac-ft/yr).

5D.10.5.5 Engineering and Costing- La Quinta

Based on information provided by City staff and its consultant, the following costs were identified for the La Quinta Channel seawater desalination project as shown in Table 5D.10.5 and Table 5D.10.6:

- Total estimated construction costs for a 20 mgd La Quinta facility $420 million.
- Total estimated construction costs for a 40 mgd La Quinta facility $768 million.
- Lifecycle water production costs, at the fence, are estimate to be $8.59 per 1,000 gallons with debt service at the 20 MGD La Quinta facility.
- Lifecycle water production costs, at the fence, are estimate to be $7.81 per 1,000 gallons with debt service for a plant located at the 40 MGD La Quinta facility.

Details regarding intake, desalination process, concentrate disposal outfall, and site-specific environmental impacts for transmission and delivery is unavailable at this time. A 11,800 ft raw water pipeline, 14,500 ft concentrate discharge pipeline, and 2,000 ft product water delivery line are included in the cost estimate, based on information provided by Freese and Nichols.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the Unified Costing Model tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around $62,720,000 to $114,102,000. This results in a unit cost of water of $2,800 to $2,547 per ac-ft after debt service for La Quinta sites with plant size ranging from 20-40 MGD. Private industry partnerships and funding structures may be considered to help reduce costs and minimize treatment plant operation and maintenance risks assumed by City operators, which may account for costing differences as compared to information shown in Table 5D.10.5 and Table 5D.10.6. The information presented in the tables was developed based on capital costs, project costs, and annual water productions costs provided by Freese and Nichols, updated using the UCM and is relevant for desalination distribution near the facility. Delivery costs to specific industries or municipal distribution system are not included.

Table 5D.10.5. Cost Estimate Summary, City of Corpus Christi- La Quinta 20 mgd Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline	$78,000,000
Storage Tanks (Other Than at Booster Pump Stations)	$13,000,000
Water Treatment Plant (20 MGD)	$214,883,000
Total Cost of Facilities	**$305,883,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$103,159,000
Land Acquisition and Surveying (19 acres)	$79,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,251,000
Total Cost of Project	**$420,372,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$29,578,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$910,000
Water Treatment Plant	$32,232,000
Total Annual Cost	**$62,720,000**
Available Project Yield (acft/yr)	22,402
Annual Cost of Water ($ per acft),	$2,800
Annual Cost of Water After Debt Service ($ per acft),	$1,479
Annual Cost of Water ($ per 1,000 gallons),	$8.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$4.54

Note: Costs based on information provided by the City of Corpus Christi. The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

Table 5D.10.6.
Cost Estimate Summary,
City of Corpus Christi- La Quinta 40 mgd Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline (raw water piping/intake; brine concentrate disposal x 2)	$113,000,000
Storage Tanks (and Delivery) x 2	$26,000,000
Water Treatment Plant (40 MGD)	$390,940,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$179,829,000
Land Acquisition and Surveying (33 acres)	$138,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$58,568,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	$54,071,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,390,000
Water Treatment Plant	$58,641,000
Available Project Yield (acft/yr)	44,804
Annual Cost of Water ($ per acft)	$2,547
Annual Cost of Water After Debt Service ($ per acft)	$1,340
Annual Cost of Water ($ per 1,000 gallons)	$7.81
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$4.11

Note: Costs based on information provided by the City of Corpus Christi. The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

5D.10.5.6 Environmental Issues

The two project areas being considered by the City of Corpus Christi for the proposed desalination plant are the Inner Harbor and La Quinta sites. The La Quinta option is located on Corpus Christi Bay, east of the inlet to Nueces Bay; the Inner Ship Channel option is located along the Main Turning Basin, near the outlet to Corpus Christi Bay. The specific siting information is still to be determined, but each proposed desalination plant site would be approximately 10 acres in size. Key factors considered in the selection of these two locations are the availability of power, proximity to the water transmission system, the character of the source water, location of a suitable concentrate discharge location, among other environmental considerations.[14]

Specific siting information for the discharge of desalination concentrate will be determined during project design. Since the desalination concentrate will be saltier than the receiving waters, the

[14] City of Corpus Christi Desalination Project Frequently Asked Questions (https://www.cctexas.com/sites/default/files/water-desal-faq-022819.pdf)

City of Corpus Christi has stated that a diffusing system would be desirable to remix the concentrate with the source water. Additional chemicals, which may be used during the filtering/treating process, may be present in the concentrate. The outfall for brine concentrate will need to consider impacts to the estuary and bay system. Prior to construction, site specific environmental studies will need to be conducted to evaluate all potential impacts to the environment, and identify best management practices to eliminate or reduce adverse impacts. [15] The City plans to submit water rights and discharge permit applications to TCEQ in 2020.

Inner Harbor Desalination Site

The Texas Parks and Wildlife Department maintains the Texas Natural Diversity Database (TXNDD) which documents the occurrence of endangered, threatened and rare species, natural communities, and animal aggregations. The TXNDD data was reviewed for recorded occurrences of listed or rare species or natural communities, near the proposed project. The plains spotted skunk (*Spilogale putorius interrupta*), a rare species has been documented at the project site. The West Indian manatee (*Trichechus manatus*), a federally-listed threatened species, and a marine mammal with protections under the Marine Mammal Protection Act has been documented within two miles of the proposed project site. Three rare species, the Texas diamondback terrapin (*Malaclemys terrapin littoralis*), Texas stonecrop (*Lenophyllum texanum*), and Texas windmill grass (*Chloris texensis*) have also been documented within two miles of the proposed project. The TXNDD data identified a colonial wading bird colony (rookery) on the northeast side of the causeway (US 181) across Nueces Bay.

National Wetland Inventory (NWI) maps were reviewed and the proposed Inner Harbor Desalination site may be in close proximity to estuarine and marine deepwater habitat, freshwater ponds, and freshwater emergent wetlands. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

The proposed desalination plant would be located on the Inner Harbor. The Corpus Christi Inner Harbor (TCEQ Segment 2484) is listed as impaired on TCEQ's 2020 Draft 303(d) List[16] for copper in the water. Within approximately 5 miles, several Corpus Christi Bay Recreational Beaches (TCEQ Segments 2481CB_03, _04 and _06) are listed as impaired for bacteria in water. Additionally, the inlet to Nueces Bay (Oyster Water) (TCEQ Segment 2482OW) is likely within 5 miles of the proposed desalination plant and is listed as impaired for copper in water.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National

[15] City of Corpus Christi Desalination Project Frequently Asked Questions (https://www.cctexas.com/sites/default/files/water-desal-faq-022819.pdf)
[16] TCEQ, 2020. Draft 2020 Texas Integrated Repot – Texas 303(d) List (Category 5). Accessed online https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf January 13, 2020.

Register Properties or Districts, cemeteries or Historical Markers within the project area. Two cemeteries, New Bayview and Old Bayview, as well as five sites listed on the National Register of Historic Places, the Nueces County Courthouse, Simon Gugenheim House, Charlotte Sidbury House, S. Julius Lichtenstein House, and the U.S.S. Lexington were located within approximately one mile from the project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the proposed project, the City of Corpus Christi, is a political subdivision of the State of Texas they will be required to coordinate with the Texas Historical Commission prior to project construction.

La Quinta Desalination Site

The TXNDD data was reviewed for documented occurrences of listed or rare species or natural communities near the project area. The federally-listed endangered jaguarundi (*Felis yagouaroundi cacomitli*), as well as several rare species or SGCN, the keeled earless lizard (*Holbrookia propinqua*), coastal gay-feather (*Liatris bracteata*), threeflower broomweed (*Thurovia triflora*), Indianola beakrush (*Rynchospora indianolensis*), and Wright's trichocoronis (*Trichocoronis wrightii var wrightii*) have been documented within two miles of the proposed La Quinta site. Additionally, a rookery was documented on the spoil banks in Corpus Christi Bay, located southeast of the project area.

National Wetland Inventory (NWI) maps were reviewed and the proposed La Quinta Desalination site may be in close proximity to estuarine and marine deepwater habitat, estuarine and marine wetlands, freshwater ponds, and lakes. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

The proposed desalination plant would be located on the Corpus Christi Bay (TCEQ Segment 2481OW).[17] This Segment is not listed as impaired on the 2020 Draft 303(d) List. No impaired water quality segments are likely located within 5 miles of the proposed project site.

Based on the review of publicly available GIS records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area, or within one mile of the proposed project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the proposed project, the City of Corpus Christi, is a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

5D.10.5.7 Implementation Issues

The installation and operation of a seawater desalination water treatment plant may have to address the following issues.

[17] TCEQ, 2020. Surface Water Quality Viewer. Accessed online tceq.maps.arcgis.com January 13, 2020.

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and constructing concentrate pipeline through seagrass beds and barrier island, including conforming with applicable laws and regulations including:
    - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
    - Endangered Species Act compliance and TPWD coordination, if required
    - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
    - TCEQ Water Right, TPDES, stormwater, and associated construction permits
    - Associated TCEQ registrations
    - Local land use and construction permits
    - GLO permitting requirements
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permits;
- Confirming that blending desalted seawater with other water sources in the municipal demand distribution system can be successfully accomplished;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using design, build, operate contract for a desalination water treatment plant.

5D.10.5.8 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.10.7.

Table 5D.10.7. Evaluation Summary of the City of Corpus Christi's Inner Harbor and La Quinta Seawater Desalination Projects

Impact Category	Comment(s)
a. Water supply: 1. Quantity 2. Reliability 3. Cost of treated water	 1. Project size: Inner Harbor: 11,201 ac-ft/yr) to 33,604 ac-ft/yr and La Quinta: 22,402 ac-ft/yr) to 44,804 ac-ft/yr 2. Highly reliable quantity. 3. Cost for Inner Harbor: $2,555 to $3,218 and La Quinta $2,547 to $2,800 perac-ft.
b. Environmental factors: 1. Instream flows 2. Bay and estuary inflows and arms of the Gulf of Mexico 3. Wildlife habitat 4. Wetlands 5. Threatened and endangered species 6. Cultural resources 7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	 1. None or low impact. 2. Some environmental impact to estuary. 3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. 4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. 5. None identified. Endangered species survey will be needed to identify impacts. 6. Cultural resources survey will be needed to identify any significant sites. 7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed.
c. Impacts to agricultural resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts to water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5D.10.6 Poseidon Regional Seawater Desalination Project at Ingleside

5D.10.6.1 Description of Strategy

Desalting seawater from the Gulf of Mexico is a potential source of freshwater supplies for municipal and industrial uses. The City of Ingleside, as a project sponsor, has initiated a process with Poseidon Water to evaluate, design, build, finance, operate and maintain a large-scale seawater desalination plant in San Patricio County. The project contemplates delivery of the facility via a Public-Private-Partnership (P3), however costs shown in the 2021 Region N Plan will be based on the unified costing model tool comparable to other water management strategies, per TWDB guidelines. The project sponsor and Poseidon Water expect the actual costs of the project to be lower than those projected by the unified costing model tool. As a comparison, the project sponsor and Poseidon Water P3 project delivery indicates costs in the range of between $4.78 and $5.60 per kgal for first phase at 50 MGD and $3.41 - $4.02 for second phase (50 MGD additional treatment capacity).

The initial desalination project is for a 50 MGD desalination facility, expandable to up to 100 MGD (112,000 acre-feet-per-year) to meet future industrial demand. The general location for the siting of the plant is within the city limits of Ingleside and potential service area is shown in the map in Figure 5D.10.4. Although the project could be configured to provide water for municipal purposes, if desired by regional entities, the singular focus and evaluation is based on development, production and treatment of seawater via reverse osmosis for new manufacturing (industrial) uses in San Patricio County.

Source: Poseidon Water Map, 2019 via email September 2019

Figure 5D.10.4.
Proposed Location for Poseidon Regional Seawater Desalination Project at Ingleside

It is estimated that the first 50 MGD phase of water supply will be needed in the 2020 decade. Additional treatment trains would be constructed as demand for water and need to produce is identified and desired. The plant is expected to have a 45% recovery rate. That is, at maximum anticipated production, it would divert approximately 225 MGD of seawater to produce 100 MGD of treated desalinated water for manufacturing purposes and potentially additional water for brine dilution. The water quality data at La Quinta Channel in Corpus Christi Bay indicates the seawater (source water) salinity ranges from 14,550 mg/L to 40,500 mg/L, with an average salinity of 31,600 mg/L over a 35-year period from 1985 to 2019. Discharge of the reverse osmosis (RO) concentrate will contribute additional salt load to the La Quinta ship channel, and the design of outfall will seek to minimize impact to intake quality. It should be noted that this strategy cost may not be comparable to other seawater desalination project strategies that have concentrate disposal in deeper water at significant distance from intake as to minimize comingling with concentrate. Final intake and outfall locations will be governed by available land acquisition and hydrodynamic modeling. According to project sponsors, preliminary conversations with hydrodynamic modelers familiar with the Corpus Christi Bay system have indicated that there is expected to be adequate tidal exchange and transfer to allow several large-scale seawater desalination plants to be permitted and operated successfully without any material environmental impacts to the Corpus Christi Bay system. There is potential wastewater reuse from industrial return flows as well as municipal wastewater discharges including possible expansion of Ingleside's wastewater treatment facilities through contract with Ingleside for the recapture and reuse of wastewater effluent in the desalination process and/or brine disposal treatment facilities. The final decisions regarding use of wastewater discharge require interest and cooperation amongst parties involved including review of any impacts to TCEQ Agreed Order return flow provisions. Water diversions from Corpus Christi Bay are not anticipated nor allowed to impact any other issued rights in the basin, nor impact environmental flow requirements.

5D.10.6.2 Available Yield

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The estimated supply is up to 112,000 ac-ft per year (100 MGD) based on the size of the desalination plant to meet new manufacturing demands in San Patricio County.

5D.10.6.3 Environmental Issues

The Poseidon Regional Seawater Desalination Project at Ingleside is a cooperative effort between Ingleside and Poseidon Water, which is pursuant to a Memorandum of Understanding between the groups. The proposed project is located on the northeast side of Corpus Christi Bay near Ingleside. The proposed desalination plant would utilize RO to treat seawater from the Gulf of Mexico and produce 50 MGD initially. At full capacity, the plant would be expected to divert approximately 225 MGD of seawater to produce 100 MGD. This strategy is primarily focused on treatment of seawater for new manufacturing (industrial) uses and to support future economic growth, rather than to serve the needs of existing water users. As of August 2019, two potential sites have been identified within the siting investigation area.[18]

This project is currently working to identify a site for the proposed seawater desalination plant, and has identified two sites within the project siting investigation area provided. Poseidon has indicated that construction of the plant would be expected to occur in a previously developed industrial area. Corpus Christi Bay (TCEQ Segment 2481), where the proposed desalination intake/outfall locations will be located, has no impairments listed, but Corpus Christi Bay – recreational beaches (TCEQ Segment 2481CB_03, 04, and 06) are listed on the Clean Water Act, Section 303(d) list for impairment due to bacteria.

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[18] Poseidon Water, 2019. Evaluation Summary of the Coastal Bend Regional Seawater Desalination Plant Option – Final82819.docx. Dated August 2019.

The TXNDD data, maintained by the TPWD was reviewed for documented occurrences of threatened, endangered or rare species or natural communities near the proposed project area. Currently, the proposed project location covers a large geographic area. Within the project siting investigation area, the federally-endangered jaguarundi (*Felis yaguarondi*) has been documented, as well as the state threatened Texas scarlet snake (*Cemophora coccinea lineri*), and four SGCN, the keeled earless lizard (*Holbrookia propinqua*), threeflower broomweed (*Thurovia triflora*), tree dodder (*Cuscuta exaltata*), and sand Brazos mint (*Brazoria arenaria*). The coastal live oak-redbay species was identified on the southern portion of the proposed project location. The West Indian manatee (*Trichechus manatus*) was documented near Ingleside Point; the rare Indianola beakrush (*Rynchospora indianolensis*) was documented in Ingleside; and, four rookeries have been documented within two miles of the proposed project area on small spoil islands just offshore in Corpus Christi Bay. Site specific surveys to determine potential impacts to threatened, endangered, or rare species and habitats should be completed as design progresses.

National Wetland Inventory (NWI) maps were reviewed and the proposed Poseidon Ingelside Desalination site may be in close proximity to estuarine and marine deepwater habitat, estuarine and marine wetlands, freshwater ponds, and numerous freshwater emergent wetlands. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

The proposed desalination plant would be located on the Corpus Christi Bay (TCEQ Segment 2481OW). This segment is not listed on TCEQ's 2020 Draft 303(d) List[19] and no impaired water quality segments are located within 5 miles.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area, or within one mile of the proposed project area. Although several archeological surveys have been conducted within the project area, a review of archaeological resources in the proposed project area should be conducted during the project planning phase. If the owner or controller of the project is a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction in accordance with the Texas Antiquities Code.

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[19] TCEQ, 2020. Draft 2020 Texas Integrated Repot – Texas 303(d) List (Category 5). Accessed online https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf January 13, 2020.

5D.10.6.4 Engineering and Costing

Some of the cost associated with the project are summarized below:

- Total estimated project cost for a 50 mgd facility located in Ingleside is $724,984,000.
- Total estimated project cost for a 100 mgd facility located in Ingleside is $1,280,848,000.
- Lifecycle water production costs, at the fence, are estimate to be $6.77 per 1,000 gallons at Ingleside for a 50 mgd facility.
- Lifecycle water production costs, at the fence, are estimate to be $6.00 per 1,000 gallons at Ingleside for a 100 mgd facility.

Details regarding intake, desalination process, concentrate disposal outfall, site-specific environmental impacts, and storage needs is unavailable at this time and was not included in the cost estimate. A 3.5 mile (18,480 ft) product water delivery line for delivery to the industrial complex in San Patricio County is included in the cost estimate, based on information provided by Poseidon Water.. Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the Unified Costing Model tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around $123,638,000 to $218,932,000. This results in a unit cost of water of $1,955 to $2,206 per ac-ft. Private industry partnerships and funding structures may be considered to help reduce costs and minimize treatment plant operation and maintenance risks assumed by City operators. The information presented in Table 5D.10.8 and Table 5D.10.9 was developed based on capital costs, project costs, and annual water productions costs with information provided by the City of Ingleside and Poseidon.

Table 5D.10.8.
Cost Estimate Summary Poseidon Regional Seawater Desalination Project at Ingleside 50 MGD Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station (50 MGD, 1,240 HP)	$6,538,000
Transmission Pipeline (60 in dia., 3.5 miles)	$10,679,000
Water Treatment Plant (50 MGD)	$478,968,000
Total Cost of Facilities	**$496,185,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$173,131,000
Environmental & Archaeology Studies and Mitigation	$201,000
Land Acquisition and Surveying (51 acres)	$214,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$55,253,000
Total Cost of Project	**$724,984,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$51,011,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$107,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$163,000
Water Treatment Plant	$71,845,000
Pumping Energy Costs (6395777 kW-hr @ 0.08 $/kW-hr)	$512,000
Total Annual Cost	**$123,638,000**
Available Project Yield (acft/yr)	56,044
Annual Cost of Water ($ per acft),	$2,206
Annual Cost of Water After Debt Service ($ per acft),	$1,296
Annual Cost of Water ($ per 1,000 gallons),	$6.77
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$3.98

Note: The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

Table 5D.10.9.
Cost Estimate Summary Poseidon Regional Seawater Desalination Project at Ingleside 100 MGD Desalination Project (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station (100 MGD, 2,483 HP)	$12,589,000
Transmission Pipeline (78 in dia., 3.5 miles)	$15,183,000
Water Treatment Plant (100 MGD)	$848,803,000
Total Cost of Facilities	**$876,575,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$306,042,000
Environmental & Archaeology Studies and Mitigation	$296,000
Land Acquisition and Surveying (76 acres)	$318,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$97,617,000
Total Cost of Project	**$1,280,848,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$90,122,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$152,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$315,000
Water Treatment Plant	$127,320,000
Pumping Energy Costs (12792919 kW-hr @ 0.08 $/kW-hr)	$1,023,000
Total Annual Cost	**$218,932,000**
Available Project Yield (acft/yr)	112,000
Annual Cost of Water ($ per acft),	$1,955
Annual Cost of Water After Debt Service ($ per acft),	$1,150
Annual Cost of Water ($ per 1,000 gallons),	$6.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$3.53

Note: The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

5D.10.6.5 Implementation Issues

Permitting of this facility will require extensive coordination with all applicable regulatory entities. The major project components and issues with implementation will be permitting and construction of pipelines. Also this strategy contemplates a P3 delivery mechanism calling for risk transference to a private party to Design-Build-Finance-Operate-and-Maintain the project. Ownership of the project may reside with the City of Ingleside, regional partners (public and private) that join the project, or Poseidon. If ownership is not with a public entity, a contract would include how transfer of ownership will be undertaken at intervals in the operation of the project or contract term end.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues prior to implementation:

- Disposal of concentrated brine from desalination water treatment plant;

- Permitting and construction, which may include:
  - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
  - Endangered Species Act compliance and TPWD coordination, if required
  - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
  - TCEQ Water Right, TPDES, stormwater, and associated construction permits
  - Associated TCEQ registrations
  - Local land use and construction permits
  - GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permit;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.
- The project is a P3 project with ownership of the project residing with the City of Ingleside, regional partners (public and private), or Poseidon. There may be a need for ownership transfer in the project contract and terms.

5D.10.6.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.10.10.

Table 5D.10.10.
Evaluation Summary of the Poseidon Regional Seawater Desalination Project at Ingleside Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 56,000-112,000 ac-ft/yr;
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Unit cost between $1,955 - $2,206 ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Corpus Christi Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project • Project does not include off-shore brine disposal.
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impact of water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5D.10.7 Port of Corpus Christi Authority Seawater Desalination Project- Harbor Island

5D.10.7.1 Description of Strategy

The Port of Corpus Christi Authority (PCCA) has proposed two desalination strategies in Nueces and/or San Patricio Counties to meet manufacturing water demands beginning in the 2020 planning decade. PCCA is a political subdivision of the State of Texas and is governed by seven commissioners. It is one of the largest energy hubs with a gateway to global markets and has recently rebranded itself as The Energy Port of the Americas. Recent years have seen considerable economic and development growth due to the ship channel expansion project around the Port, primarily related to the oil and gas industry. The Port is a multi-billion dollar enterprise affecting the entire state. Although it has the authority to tax, none of its revenue is generated through taxes. All Port revenues are generated through tonnage fees and rent. In 2017, PCCA directed staff to evaluate two sites for future desalination plants on PCCA's property. The proposed sites are on Harbor Island and at the north end of La Quinta Channel. PCCA is in the process of seeking discharge permits from TCEQ and water rights applications have been submitted. The Port intends to complement the City of Corpus Christi's efforts to implement desalination in the region.

The Harbor Island project site is located on the Corpus Christi Ship Channel near Port Aransas as shown in Figure 5D.10.5. It will produce 50 MGD for both municipal and industrial use, utilize RO to treat seawater from the Gulf of Mexico, and a proposed diffuser would discharge into the Corpus Christi Ship Channel. The following status report was provided by PCCA. The water rights permit has not yet been submitted for the Harbor Island project because a review of available data is underway to determine intake placement in the Gulf of Mexico. The TCEQ discharge permit was filed in 2018. The discharge permit has been ruled administratively complete, and the public comment /meeting process has been completed. There was a public meeting in Port Aransas in April 2019. In response to TCEQ Executive Director's recommendation that the TCEQ Commissioners grant the discharge permit, the City of Port Aransas, PAC, and others petitioned for a contested case hearing. TCEQ Commissioners directed the permit to the State Office of Administrative Hearings (SOAH) for a contested case hearing. After the preliminary hearing is held in 2020, SOAH will then have 180 days to make a recommendation back to TCEQ.

Source: PCCA/Naismith/Hanson, 2019 via email December 2019

Figure 5D.10.5.
Proposed Location for PCCA Seawater Desalination Project at Harbor Island

5D.10.7.2 Available Yield- PCCA Harbor Island

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The estimated supply is up to 56,044 ac-ft per year (50 MGD) based on the size of the desalination plant to meet end user customer needs.

5D.10.7.3 Environmental Issues- PCCA Harbor Island

The Harbor Island project site is located on the Corpus Christi Ship Channel across from Port Aransas. Construction of the facility would impact approximately 33 acres in a former fuel tank storage area, which is currently vacant. The proposed desalination plant would utilize RO to treat seawater from the Gulf of Mexico and produce 50 MGD for both municipal and industrial use. The Port submitted a discharge permit for the project in 2018; this permit has not been granted and a decision is expected in 2020. The Port is currently studying proposed intake locations prior to submitting an application for water rights. This project has garnered public opposition from environmental groups due to potential impacts to estuaries, wildlife, seagrass, and salinity levels. The Port proposed to discharge water via an HDPE pipeline to a multi-port diffuser approximately 300 feet offshore on the south side of Harbor Island in Corpus Christi Channel (TCEQ Segment 2481). From there, the discharge would flow either into the Gulf of

Mexico via Aransas Pass or through the Corpus Christi Channel toward Corpus Christi Bay. Water would be sampled (to determine characteristics of the effluent discharge) following comingling of all wastewaters prior to discharge.[20] Modeling completed by the Port, indicates that brine discharge released from the desalination plant would increase the ambient concentration less than 1% beyond the aquatic life mixing zone. They conclude that this increase would be insignificant compared to the natural variation in salinity observed in Corpus Christi Bay and would not cause degradation of local water quality.[21]

TPWD maintains the Texas Natural Diversity Database (TXNDD) which documents the occurrence of endangered, threatened and rare species, natural communities, and animal aggregations. The TXNDD data was reviewed for recorded occurrences of listed or rare species or natural communities, near the proposed project. The Tharp's dropseed (*Sporobolus tharpii*), a rare species has been documented at the project site. The West Indian manatee (*Trichechus manatus*), a federally-listed threatened species, and a marine mammal with protections under the Marine Mammal Protection Act, the green sea turtle (*Chelonia mydas*), a federal and state listed threatened species, the Atlantic hawksbill sea turtle (*Eretmochelys imbricata*) a federal and state listed endangered species, the Texas horned lizard (*Phrynosoma cornutum*) a state threatened species, the Piping Plover (*Charadrius melodus*) a federal and state listed threatened species, and velvet spurge (*Euphorbia innocua*) a rare species have been documented within two miles of the proposed project. The TXNDD data also identified rookeries on near the project area on Harbor Island and Mustang Island.

National Wetland Inventory (NWI) maps were reviewed and the proposed Harbor Island Desalination site may be in close proximity to estuarine and marine deepwater habitat and freshwater emergent wetlands. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the U.S. Army Corps of Engineers would be required for impacts to waters of the U.S.

The proposed desalination plant would be located on Harbor Island, which is within Redfish Bay (Oyster Waters) (TCEQ Segment 2483OW). Redfish Bay is not listed as impaired on the TCEQ 2020 Draft 303(d) List[22]. The Gulf of Mexico (TCEQ Segment 2501) is located within 5 miles of the proposed Harbor Island desalination site. Segment 2501 is listed on the 2020 Draft 303(d) List as impaired for mercury in edible tissue.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available GIS records obtained from the Texas Historical

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[20] PoCCA, 2018. Texas Commission on Environmental Quality TCEQ Industrial Wastewater Permit Application – Port of Corpus Christi Authority of Nueces County Proposed Desalination Plant – Harbor Island. Dated March 5, 2018.

[21] Amec Foster Wheeler, 2017. Process Design Basis and Narrative Port of Corpus Christi Industrial Seawater Desalination Harbor Island. December 2017.

[22] TCEQ, 2020. Draft 2020 Texas Integrated Repot – Texas 303(d) List (Category 5). Accessed online https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf January 13, 2020.

Commission, there is potentially one National Register Property and one cemetery within one mile of the proposed project area. The Tarpon Inn and Mercer Cemetery are located approximately one mile from the proposed project area in Port Aransas. No State Historic Sites, National Register Districts, or Historical Markers were identified within the project area, or within one mile of the proposed project area.

Archeological surveys have been conducted near the project area, a review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission, under the Texas Antiquities Code, prior to project construction.

5D.10.7.4 Engineering and Costing- PCCA Harbor Island

Some of the cost associated with the project are summarized below:

- Total estimated costs for a 50 mgd facility located in Harbor Island at $802,807,000.
- Assumed a 22 mile pipe to San Patricio County area and a two mile 42" pipe to Nueces County area (not shown in Figure 5D.10.5)
- Assumed 3 pipe segments: 42 inch diameter 21 miles, 36 inch diameter 1.2 miles, and 24 inch diameter 2.3 miles

Details regarding concentrate disposal outfall, site-specific environmental impacts, and storage needs are unavailable at this time and are not included in the cost estimate.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the Unified Costing Model tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around $130,167,000. This results in a unit cost of water of $2,323 per ac-ft with debt service. The information presented in Table 5D.10.11 was developed based on capital costs, project costs, and annual water productions costs with information provided by PCCA.

Table 5D.10.11. Cost Estimate Summary of the Port of Corpus Christi Authority's 50 MGD Desalination Project at Harbor Island (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station (26.3 MGD)	$12,940,000
Transmission Pipeline (42 in dia., miles)	$56,451,000
Water Treatment Plant (50 MGD)	$478,968,000
Total Cost of Facilities	**$548,359,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$189,103,000
Environmental & Archaeology Studies and Mitigation	$1,163,000
Land Acquisition and Surveying (182 acres)	$2,998,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$61,184,000
Total Cost of Project	**$802,807,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$56,486,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$565,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$324,000
Water Treatment Plant	$71,845,000
Pumping Energy Costs (11835834 kW-hr @ 0.08 $/kW-hr)	$947,000
Total Annual Cost	**$130,167,000**
Available Project Yield (acft/yr)	56,044
Annual Cost of Water ($ per acft),	$2,323
Annual Cost of Water After Debt Service ($ per acft),	$1,315
Annual Cost of Water ($ per 1,000 gallons),	$7.13
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$4.03

Note: The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

5D.10.7.5 Implementation Issues- PCCA Harbor Island

Permitting of this facility will require extensive coordination with all applicable regulatory entities. The major project components and issues with implementation will be permitting and construction of pipelines.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues to implementation:

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and construction, which may include:
  - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
  - Endangered Species Act compliance and TPWD coordination, if required
  - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
  - TCEQ Water Right, TPDES, stormwater, and associated construction permits
  - Associated TCEQ registrations
  - Local land use and construction permits
  - GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permit;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

5D.10.7.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.10.12.

Table 5D.10.12. Evaluation Summary of the Port of Corpus Christi Authority- Harbor Island 50 MGD Seawater Desalination Option(s)

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 56,044 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Unit Cost $2,323 /ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts of water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5D.10.8 Port of Corpus Christi Authority Seawater Desalination Project- La Quinta Channel

5D.10.8.1 Description of Strategy

The Port of Corpus Christi Authority (PCCA) has proposed two desalination strategies in Nueces and/or San Patricio Counties to meet manufacturing water demands beginning in the 2020 planning decade. PCCA is a political subdivision of the State of Texas and is governed by seven commissioners. It is one of the largest energy hubs with a gateway to global markets and has recently rebranded itself as The Energy Port of the Americas. Recent years have seen considerable economic and development growth due to the ship channel expansion project around the Port, primarily related to the oil and gas industry. The Port is a multi-billion dollar enterprise affecting the entire state. Although it has the authority to tax, none of its revenue is generated through taxes. All Port revenues are generated through tonnage fees and rent. In 2017, PCCA directed staff to evaluate two sites for future desalination plants on PCCA's property. The proposed sites are on Harbor Island and at the north end of La Quinta Channel. PCCA is in the process of seeking discharge permits from TCEQ and water rights applications have been submitted. The Port intends to complement the City of Corpus Christi's efforts to implement desalination in the region.

The La Quinta site is located near the La Quinta Ship Channel in San Patricio County. It will produce 30 MGD for primarily industrial use, utilize RO to treat seawater from Corpus Christi Bay, and a proposed diffuser would discharge into the La Quinta Ship Channel. Approximately 27 miles of pipeline will be used to deliver water to customers in the area. The TCEQ permit for the La Quinta Channel project was filed on September 3, 2019; TCEQ is reviewing additional information to make completeness determination; and public comment occurred in December 2019. Figure 5D.10.6 shows the proposed pipeline route for this project.

Source: PCCA/Naismith/Hanson, 2019 via email December 2019

Figure 5D.10.6.
Proposed Location for Seawater Desalination Program at La Quinta

5D.10.8.2 Available Yield- PCCA La Quinta Channel

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The estimated supply is up to 33,627 ac-ft per year (30 MGD).

5D.10.8.3 Environmental Issues- PCCA La Quinta Channel

As of September 2019, the Port filed applications with the TCEQ for water rights and discharge permits for the proposed desalination plant. This site, located near the La Quinta Ship Channel in San Patricio County, would utilize RO to treat seawater and produce approximately 30 MGD of treated water for industrial use. This facility has a design intake flow of 90.4 MGD from Corpus Christi Bay.[23] This project is expected to discharge through a diffuser into the La Quinta Ship Channel.

[23] PoCCA, 2019. TCEQ Water Rights Permitting Application Port of Corpus Christi Authority of Nueces County. Proposed Desalination Plant, La Quinta. Dated August 29, 2019.

The TXNDD data was reviewed for documented occurrences of listed or rare species, or natural communities near the project area. There were no documented occurrences of listed or rare species or communities within two miles of the proposed project area.

National Wetland Inventory (NWI) maps were reviewed and the proposed Port of Corpus Christi Authority La Quinta Desalination site may be in close proximity to estuarine and marine deepwater habitat and freshwater emergent wetlands. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the U.S. Army Corps of Enineers would be required for impacts to waters of the U.S.

The proposed desalination plant would be located on the Inner Harbor. The Corpus Christi Inner Harbor (TCEQ Segment 2484) is listed as impaired on TCEQ's 2020 Draft 303(d) List[24] for copper in the water. Within approximately 5 miles, several Corpus Christi Bay Recreational Beaches (TCEQ Segments 2481CB_03, _04 and _06) are listed as impaired for bacteria in water. Additionally, the inlet to Nueces Bay (Oyster Water) (TCEQ Segment 2482OW) is likely within 5 miles of the proposed desalination plant and is listed as impaired for copper in water.

The proposed desalination plant would be located on the La Quinta Channel. The site would discharge into Corpus Christi Bay (TCEQ Segment 2481OW), which is not listed as impaired on TCEQ's 2020 Draft 303(d) List.[25] Within approximately 5 miles, several Corpus Christi Bay Recreational Beaches (TCEQ Segments 2481CB_03, _04 and _06) are listed as impaired for bacteria in water. Additionally, the inlet to Nueces Bay (Oyster Water) (TCEQ Segment 2482OW) and the inlet to Corpus Christi Bay Inner Harbor (TCEQ Segment 2484) are within 5 miles of the proposed desalination plant and are listed as impaired for copper in water.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area, or within one mile of the proposed project area.

Several archeological surveys have been conducted within the project vicinity, a review of archaeological resources should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission, under the Texas Antiquities Code, prior to project construction.

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[24] TCEQ, 2020. Draft 2020 Texas Integrated Repot – Texas 303(d) List (Category 5). Accessed online https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf January 13, 2020.
[25] TCEQ, 2020. Draft 2020 Texas Integrated Repot – Texas 303(d) List (Category 5). Accessed online https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf January 13, 2020.

5D.10.8.4 Engineering and Costing- PCCA La Quinta Channel

Some of the cost associated with the project are summarized below:

- Total estimated costs for a 30 mgd facility located in La Quinta at $457,732,000.
- Assumed a three mile 48" pipeline for delivery to industrial complex in San Patricio County.

Details regarding intake, desalination process, concentrate disposal outfall, site-specific environmental impacts, and storage needs is unavailable at this time and are not included in the cost estimate other than the three mile product delivery pipeline mentioned above.

Energy is the largest operational cost of a desalination facility. Energy use is directly proportional to salinity of the source water. Using the Unified Costing Model tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around $77,991,000. This results in a unit cost of water of $2,321 per ac-ft with debt service. The information presented in Table 5D.10.13 was developed based on capital costs, project costs, and annual water productions costs with information provided by PCCA.

Table 5D.10.13.
Cost Estimate Summary 30 MGD Desalination Project at La Quinta (Sept 2018 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station (0 MGD)	$2,754,000
Transmission Pipeline (0 in dia., miles)	$7,078,000
Water Treatment Plant (30 MGD)	$302,911,000
Total Cost of Facilities	**$312,743,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$109,106,000
Environmental & Archaeology Studies and Mitigation	$375,000
Land Acquisition and Surveying (38 acres)	$623,000
Interest During Construction (3% for 3 years with a 0.5% ROI)	$34,885,000
Total Cost of Project	**$457,732,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$32,207,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$71,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$69,000
Water Treatment Plant	$45,437,000
Pumping Energy Costs (2593527 kW-hr @ 0.08 $/kW-hr)	$207,000
Total Annual Cost	**$77,991,000**
Available Project Yield (acft/yr)	33,604
Annual Cost of Water ($ per acft),	$2,321
Annual Cost of Water After Debt Service ($ per acft),	$1,362
Annual Cost of Water ($ per 1,000 gallons),	$7.12
Annual Cost of Water After Debt Service ($ per 1,000 gallons),	$4.18

Note: The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

5D.10.8.5 Implementation Issues- PCCA La Quinta Channel

Permitting of this facility will require extensive coordination with all applicable regulatory entities. The major project components and issues with implementation will be permitting and construction of pipelines.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues to implementation:

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and construction, which may include:
    - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
    - Endangered Species Act compliance and TPWD coordination, if required
    - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
    - TCEQ Water Right, TPDES, stormwater, and associated construction permits
    - Associated TCEQ registrations
    - Local land use and construction permits
    - GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permit;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

5D.10.8.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5D.10.14.

Table 5D.10.14. Evaluation Summary of the the Port of Corpus Christi Authority- La Quinta Channel 30 MGD Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 33,604 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Cost $2,321 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts to water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5D.11

Regional Water Treatment Plant Facility Expansions and Improvements (N-11)

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5D.11 Regional WTP Facility Expansions and Improvements

5D.11.1 Description of Strategy

The City of Corpus Christi and San Patricio Municipal Water District (SPMWD) supply over 80 percent of the municipal and industrial water demand in the region. Treated water supply availability is limited by existing water treatment plant capacity, as well as raw water availability as described in Chapter 3. Current water treatment capacity is insufficient to utilize safe yield supplies available from the CCR/LCC/Lake Texana/MRP Phase II system and water treatment plant improvements (WTP) are necessary to meet water demand increases in the future.

SPMWD receives treated water supplies from the O.N. Stevens WTP and treats raw water supplies from the CCR/LCC/Lake Texana/MRP Phase II system with their own water treatment plant for municipal and industrial customers in San Patricio County. Due to recent amendments to the City of Corpus Christi and SPMWD treated water agreements that increased SPMWD's treated water contract to up to 37,000 acft/yr, SPMWD does not have a water treatment expansion need identified during the planning period through Year 2070. SPMWD's existing capacities at Plants A-C are sufficient to address treated water demands, considering the treated water contracts in place with the City of Corpus Christi.

The O.N. Stevens WTP provides treated water supplies to the City of Corpus Christi (City) and its customers. As shown in the City of Corpus Christi's needs analysis in Chapter 4A.4, additional treatment capacity is needed at the City's water treatment plant to fulfill contracted future treated water supplies to SPMWD and others needed to meet projected industrial water needs.

The City expects to experience increasing municipal and industrial water demands due to a growing population, enterprise, and commerce. Despite the successful water conservation efforts of the City's industrial customers, raw and treated water demand is increasing due to increased manufacturing. Not only have manufacturers indicated that they will need increasing amounts of water in the coming years, other water users have approached the City about various efforts slated to come online in the next several years with increasing rates of water consumption over a 10-year period. The projected growth in manufacturing and steam-electric demand, in combination with municipal demand, requires that the City develop additional treated water supply over the next few years.

Although the O.N. Stevens WTP is currently rated at 167 mgd by the TCEQ, the City currently can produce only 160 mgd of treated water through the O.N. Stevens WTP (the sole source of treated water for the City municipal supply, various large industrial users, and the South Texas Water Authority)[1] due to a hydraulic bottleneck at the front end of the O.N. Stevens WTP. The

[1] The City of Corpus Christi, STWA, and some industrial users rely solely on the O.N. Stevens WTP for treated water supplies, and do not have backup treatment plants or treated water furnished from other sources.

City of Corpus Christi is in the process of O.N. Stevens WTP expansions to increase treatment plant capacity from 160 MGD to 200 MGD and construction activities are underway for an estimated time of completion of 2021. Re-designing the influent end of the plant will allow the plant, operating under acceptable TCEQ detention rates, to produce 200 mgd which would increase the amount of treated water supplies needed to meet increasing water demands for City customers and improve supply reliability. Additional system improvements to the water treatment plant will provide operational cost savings from increased reliability and functionality. The proposed O.N. Stevens Water Treatment Plant Improvements are as follows:

- Raw Water Influent Improvements – these improvements will address the current hydraulic bottleneck at the O.N. Stevens WTP front end that limits total plant capacity to 159 mgd. This project, in combination with uprating the current filter system through TCEQ, will increase total plant capacity to 200 mgd.
- Nueces River Raw Water Intake Pump Station Improvements – these improvements will increase the reliability of water delivery to O.N. Stevens from the Calallen Pool.

The Raw Influent Improvements would allow for blending and pre-sedimentation of 100% of the source water which would increase finished water quality, as well as allow for a more uniform treatment regimen which would save operational costs. Full blending and full pre-sedimentation will also accomplish the goal of increasing the quality of the partially treated water that is provided to local industry. Raw Influent Improvements will also increase security at the O.N. Stevens WTP as currently the influent pipelines emerge in an open top meter vault only a few feet from a major road, which is a security concern.

The Nueces River Raw Water Intake Pump Station Improvements will upgrade the pump station in order to increase the reliability of water delivery to O.N. Stevens WTP. The upgrades will also increase the operational capability of the pump station and provide operational cost savings from the increased reliability and capabilities of the improved pump station, including new pump motors and motor starters to be installed.[2]

In addition to the projects detailed above, the City is also in the process of adding water treatment plant improvements to the chemical feed system, electrical distribution system, process monitoring instrumentation and automation system, and residual solids handling and water recovery facilities. Such improvements are not fully discussed in this water management strategy and are not included in the cost estimate.

[2] The O.N. Stevens WTP currently contains emergency generators. Proposed water treatment improvements would be added to the existing electrical distribution system.

5D.11.2 Available Yield

The City currently can produce only 160 mgd of treated water due to a hydraulic bottleneck at the front end of the O.N. Stevens WTP treatment train that limits water treatment plant production. With raw water influent improvements, the O.N. Stevens WTP capacity will increase to 200 mgd (peak day).

At a current peak water treatment capacity of 160 mgd, the City is able to produce on average 114.3 mgd[3] (or 128,104 ac-ft/yr). Assuming the same peak to average day ratio, increasing the O.N. Stevens WTP capacity to 200 mgd will produce 142.9 mgd, on average, (or 160,134 ac-ft/yr) which is 32,030 ac-ft more than the amount that can be currently produced.[4]

5D.11.3 Environmental Issues

A summary of environmental issues by water treatment plant improvement component is included in Table 5D.11.1. There is little to no environmental impact from the proposed O.N. Stevens WTP projects. The majority of the work will be on existing facilities and structures.

Table 5D.11.1.
Environmental Issues City of Corpus Christi Water Supply Improvements

Water Management Strategy/Component	Environmental Impact
Raw Influent Improvements	Negligible impact. Possibility of processing more water daily by the WTP could allow for increased consumption if the demand manifests itself, but also increased B&E inflows possible as well.
Nueces River Raw Water Pump Station Improvements	Negligible impact. Upgrades to existing facility will not involve construction in river or alteration of flows, excavation, or dredging.

5D.11.4 Engineering and Costing

Figure 5D.11.1 shows the facilities required to develop the Raw Influent Improvements. The improved headworks piping at O.N. Stevens will also allow for 100% blending and pre-sedimentation of source waters which will effect water quality improvements and chemical cost savings per unit.

[3] Assumes a peak to average day rate of 1.4: 1 comparable with recent water use records.
[4] Assumes no raw water shortage.

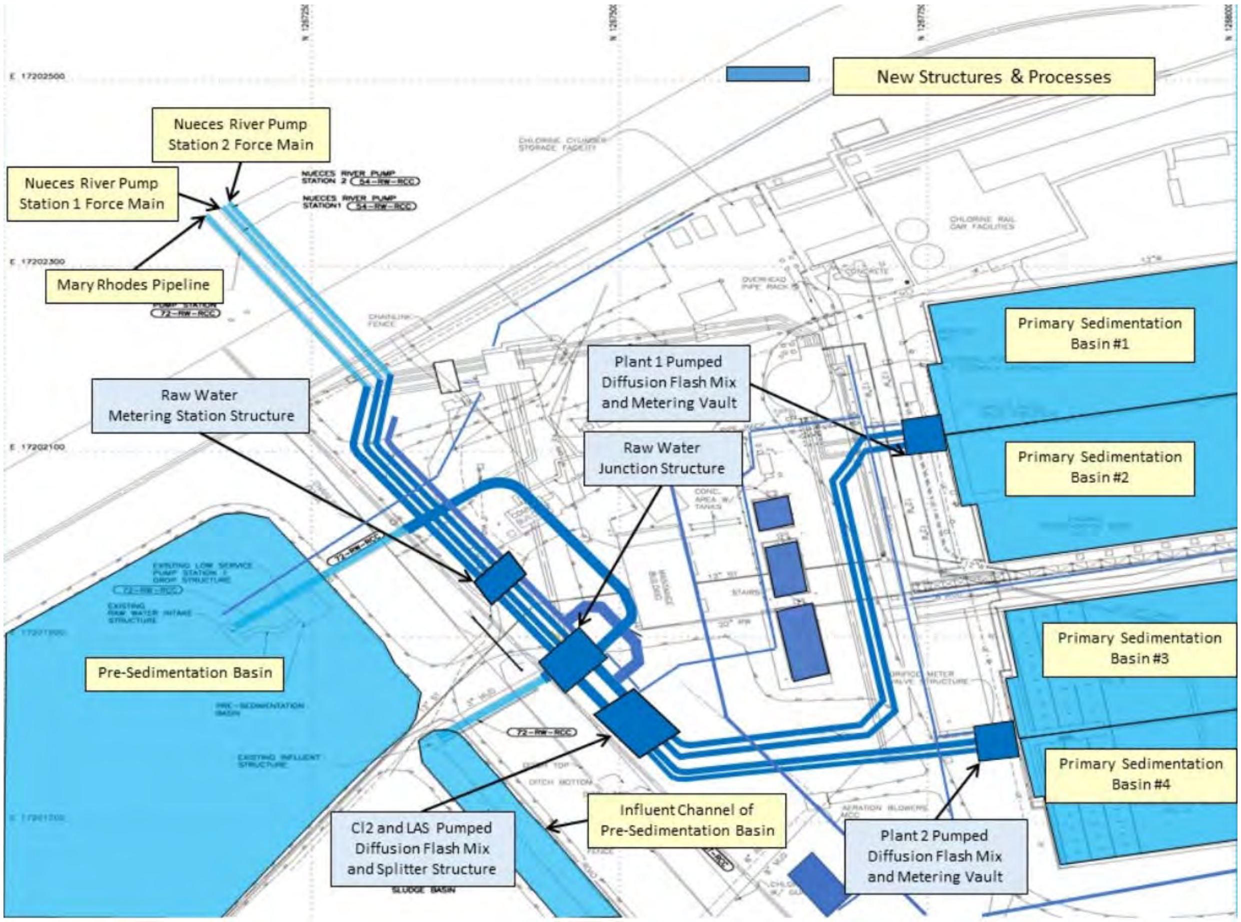

Figure 5D.11.1.
O.N. Stevens Water Treatment Plant Raw Water Influent Improvements

Table 5D.11.2 summarizes the capital and annual costs for the City's O.N Stevens WTP Improvements, while Table 5D.11.3 summarizes the available project yield subject to raw water constraints and the annual cost of water, including treated water costs with assumption of $369 per ac-ft used for other water management strategies. It is important to note that yield declines in decades subsequent to 2020 due to the need to maintain raw water supplies up to safe yield capacity constraints. With addition of new raw water supplies during the projection period, the supplies generated by O.N. Stevens WTP improvements will amount to 28,025 ac-ft/yr or raw water project yield whichever is the smaller amount.

Table 5D.11.2.
Cost Estimate Summary for O.N. Stevens WTP Improvements

Item	Estimated Costs for Facilities
Capital Cost	
Raw Influent Improvements	$35,260,000
Nueces River Raw Water Intake Pump Station Improvements	$13,915,000
Total Cost of Facilities	**$49,175,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$17,211,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,826,000
Total Cost of Project	**$68,212,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$4,799,000
Operation and Maintenance	$348,000
Pumping Energy Costs ($0.09 per kW-hr)	$1,119,000
Total Annual Cost	**$6,266,000**
Available Project Yield (acft/yr)	32,030
Annual Cost of Water ($ per acft)	$196
Annual Cost of Water After Debt Service ($ per acft)	$46
Annual Cost of Water ($ per 1,000 gallons)	$0.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.14

Table 5D.11.3.
Unit Cost of Water Summary

	Year					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Available Project Yield (ac-ft/yr)	32,030	32,030	32,030	32,030	32,030	32,030
Annual Cost of Raw Water ($ per ac-ft)	$196	$196	$196	$46	$46	$46
Annual Cost of Treated Water ($ per ac-ft)	$565	$565	$565	$415	$415	$415

5D.11.5 Implementation Issues

Implementation of these water management strategies will require a National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan Permit.

There are limited chances for participation by partners. To the extent these improvements will provide improvements in water quality or supply for wholesale finished or wholesale partially treated or wholesale raw water customers, there may be partnership opportunities with the wholesale customers.

The sequencing of construction will have to take into account the fact that the O.N. Stevens WTP is the City's only water treatment plant, so it has to keep operating throughout the construction process. There is detention time of only a few hours in the clearwells to allow for switching over to the new hydraulic structures near the end of construction. The Raw Influent Improvements Component is the only portion of the proposed improvements that will require special sequencing consideration.

5D.11.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5D.11.4.

Table 5D.11.4.
Evaluation Summary of O.N. Stevens Water Treatment Plant Improvements

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield: 32,030 ac-ft/yr, with no raw water constraints.
2. Reliability	2. High reliability.
3. Cost of treated water	3. Raw: $196 per ac-ft. Treated: $565 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will reduce demand on river water.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities may have minor reduction in inflows to tidal portion of the Nueces River.
3. Wildlife habitat	3. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will preserve minimum water levels in the Audubon Society Rookery.
4. Wetlands	4. Low or no impact.
5. Threatened and endangered species	5. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will preserve minimum water levels in the Audubon Society Rookery.
6. Cultural resources	6. Negligible impact. All work on O.N. Stevens WTP property should be no impact.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low or no impact. The O.N. Stevens WTP Solids Handling Facilities will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
c. Impacts to agricultural and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

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6

Impacts of Regional Water Plan and Consistency with Protection of Resources [31 TAC §357.40 and §357.41]

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Chapter 6: Impacts of Regional Water Plan and Consistency with Protection of Resources

The guidelines for the 2021 Regional Water Plans include describing major impacts of recommended and alternative water management strategies on key parameters of water quality identified by the regional water planning group. This also includes consideration of third party social and economic impacts associated with voluntary redistribution of water from rural and agricultural areas, and effects of ground and surface water interrelationships on water resources of the state. Furthermore, 2021 Regional Water Plans consider statutory provisions regarding inter-basin transfers of surface water including summation of water needs in basins of origin and receiving basins, as well as how the regional plan is consistent with protection of natural resources. The plan development was guided by the principal that the designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained. Each water management strategy summary (Chapter 5D) includes a discussion of these environmental considerations, impacts to agricultural resources and State water resources, threats to agricultural and natural resources, effects on navigation, and potential impacts associated with project implementation including impacts on current water supply infrastructure. Other factors included are environmental impacts, possible effects to instream flows, wildlife habitat, cultural resources, environmental water needs, and inflows to bays and estuaries and arms of the Gulf of Mexico. The 2021 Coastal Bend Regional Water Plan does not have any alternative water management strategies.

6.1 Socioeconomic Impacts of Not Meeting Identified Water Needs

At the request of the Coastal Bend Regional Water Planning Group, the TWDB[1] conducted a socioeconomic impact analysis of projected water shortages for the Region N planning area. The TWDB presented the findings of their analysis at the CBRWPG meeting on November 14, 2019. The analysis was performed using an economic impact modeling software package, IMPLAN (Impact for Planning Analysis) and represents a snapshot of socioeconomic impacts that may occur during a single year repeat of the drought of record assuming no mitigation strategies are implemented based on anticipated water supplies and demands for that same decade with no new water supply strategies being developed. The TWDB reported that Region N generated more than $31 billion in gross domestic product (GDP) in 2018 and supported roughly 328,000 jobs in 2016.

In Region N, the TWDB's socioeconomic impact report estimated that not meeting identified water needs in Region N would result in a combined lost income of approximately $732 million

[1] TWDB, Socioeconomic Impacts of Projected Water Shortages for the Coastal Bend (Region N) Regional Water Planning Area, November 2019.

and increasing to $6.9 billion in 2070. The region would also lose approximately 6,000 jobs in 2020 that would increase to losses of 48,000 jobs by 2070 if the needs were left unmet. The TWDB's Socioeconomic Impacts report is included in Appendix B.

6.2 Quantitative Impacts to Agricultural Resources and Environmental Factors

The TWDB guidance for 2021 Regional Water Plans requires evaluation of quantitative impacts to agricultural resources and environmental factors for each evaluated WMS in the plan.

Table 6-1 presents the key to the impacts to agricultural resource descriptors that are presented for each WMS evaluation summary (Chapter 5D) based on WMS project construction footprint. Additional details regarding impacts to local agricultural resources, such as impacts to ephemeral streams that might be used by local landowners for irrigation purposes are also identified based on information available.

Table 6-1.
Impacts to Agricultural Resources Key

Impacts to Agricultural Resources Key	Criteria
None or Low; Negligible	Temporary impacts to agricultural land during project construction. Occasion disturbances due to maintenance on right of way for pipelines.
Moderate; Some	Loss of up to 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).
High	Loss of more than 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).

Each strategy includes a separate Environmental Issues discussion, which describes environmental factors. Table 6-2 includes the key to the environmental issues that are presented in the evaluation summaries.

Table 6-2.
Impacts to Environmental Factors Key

Impacts to Environmental Factors Key	Criteria
None or Low; Negligible	Reduction in environmental flows with implementation of the strategy is indiscernible (less than 1%) using the approved surface water availability model, as compared to flows without the project. Wildlife habitat is not expected to be altered by the project.
Moderate; Some	Reduction in environmental flows with implementation of the strategy is expected to range from 1% to 10% using the approved surface water availability model, as compared to flows without the project. Due to the nature of the strategy, localized impacts to small creeks or on-site tanks may be noticed (up to 10%). Wildlife habitat may be temporarily impacted during project construction, but long-term impacts to wildlife habitat are not expected.
High	Reduction in environmental flows with implementation of the strategy is expected to exceed 10% using the approved surface water availability model, as compared to flows without the project. Long-term wildlife habitat alteration is highly likely with project.

6.3 Groundwater and Surface Water Interrelationships Impacting Water Resources of the State

The Nueces River from Three Rivers to the Calallen Pool (including Lake Corpus Christi), hereafter referred to as the Lower Nueces Basin, is hydraulically connected to underlying Goliad Sands and alluvial sands of the Gulf Coast Aquifer. During the development of the 2011 Region N Plan, studies were conducted to evaluate stream flow interaction with alluvial sands of the Gulf Coast Aquifer downstream of CCR to LCC using data collected during a field channel loss study and are summarized in Chapter 11.4.13. Groundwater and surface water interaction in the Lower Nueces Basin is very complex and could vary significantly based on seasonal events, antecedent drought or wet conditions and prolonged drought or wet conditions that could impact storage and released water from LCC. Additional studies were performed, as discussed in Chapters 11.3.1 and Chapter 11.4.13, to evaluate groundwater and surface water interrelationships considered to potentially impact Lower Nueces Basin water quality that may affect water supplies diverted from the Calallen Pool. The Lower Nueces River Watershed Protection Plan was created based on water quality issues for TDS and Chlorophyll-a. As part of the plan, they have identified and repaired onsite sewage facilities, thus improving water quality.

The Coastal Bend Region recognizes the importance of considering groundwater and surface water interaction when managing water resources and evaluating development of future water supplies. The Region encourages groundwater conservation districts and groundwater management areas to consider protection of springs and groundwater-surface water interaction when considering new DFCs.

6.4 Threats to Agricultural or Natural Resources

Agriculture accounts for a major portion of the land use within the Coastal Bend Region. Cultivated land is typically dryland farming, irrigated agriculture or used for livestock (for more details see Ch. 1). Fishing is another industry that adds to the economic value of the Coastal Bend Region.

Most agricultural business in the region relies on groundwater for irrigation and groundwater and local stock tanks for livestock. Continuing groundwater depletion is a threat to agricultural and natural resources. The Coastal Bend Region also recognizes the following additional potential threats to agricultural and natural resources:

- Shortage of freshwater and economically accessible groundwater attributable to increased irrigation demands.
- Shortage of freshwater and economically accessible groundwater attributable to development of natural gas from the shale in the Eagleford Group and water demands associated with hydraulic fracturing of wells.
- Deterioration of surface water quality associated with sand and gravel operations and other activities.
- Deterioration of groundwater quality and increasing concerns of possible arsenic and uranium contamination attributable to uranium mining activities.

- Potential impacts to threatened, endangered, and other species of concern.
- Potential impacts of brush control and other land management practices as currently considered in Federal studies.
- Natural disasters or other critical storms.
- Abandoned wells (oil, gas, and water).

These threats to agricultural or natural resources are considered for each water management strategy, and when applicable, are specifically addressed in the Chapter 5D water management strategy evaluation.

While the Coastal Bend Region is known for its valuable mineral resources, especially oil and gas, the area also contains a rich diversity of living natural resources. This region also has many migratory flyways and birds comprise a major portion of the wildlife population found within the area. The Coastal Bend Region provides many birds unique nesting and forage resources within its coastal prairies, wetlands, and riverine ecosystems. Texas Parks and Wildlife and U.S. Fish and Wildlife Service - Southwest Region Ecological Service maintain maps identifying potential habitats (by county) of each endangered or threatened species. A summary of Endangered and Threatened Species for the 11-county region is included in Chapter 1. These potential habitats are considered for each water management strategy and when possibly impacted, are noted in the appropriate water management strategy summary (Chapter 5D).

6.5 Third Party Social and Economic Impacts Resulting from Voluntary Redistribution of Water Including Impacts of Moving Water from Rural and Agricultural Areas

Several opportunities for voluntary redistribution exist for the Coastal Bend Region, including reallocating surface water through utilization of unused supply and sales of existing rights, or reallocating modeled available groundwater (MAG) through transfer of unused supply for entities with a surplus of groundwater to entities needing to drill additional wells as discussed in Chapter 5D.8.

Reallocation of unutilized surface water supply was considered but not recommended as a water management strategy. Based on existing water supply contract relationships, it is anticipated that the City of Three Rivers will continue to supply water to Live Oak-Manufacturing in addition to future manufacturing needs being met by drilling additional wells. Similarly, Nueces County WCID #3 will continue to meet the needs for Robstown and River Acres WSC by implementing the recommended strategy identified in Chapter 5D.6. The impacts of voluntary redistribution of un-utilized surface water supply are expected to have minimal or no impacts on third party users or rural and agricultural areas.

Groundwater supplies were determined by comparing the MAG-preserved well capacities for each WUG that has historically relied on groundwater to projected demands. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower. For water user groups that use both groundwater and surface water supplies, it was assumed that the water user group would use groundwater up to its well capacity (limited by MAG) and then use available surface water per rights or contracts to total the projected water demand through combination of groundwater and surface water supplies. The CBRWPG assumes that excess groundwater beyond demands is not pumped and therefore available as a collective resource for future water management strategy development subject to adopted MAGs, which are established based on desired future conditions established by the local groundwater conservation districts and groundwater management areas.

The water management strategies recommended to meet water needs (Chapter 5) do not include transferring water needed by rural and agricultural users and, therefore, are not considered to impact them.

6.6 Impacts of Recommended Water Management Strategies on Key Parameters of Water Quality

The CBRWPG identified the following key parameters of water quality to consider for WMS in the 2021 Regional Water Plan. The selection of key water quality parameters are based on water quality concerns identified in the Nueces River Authority's 2019 Basin Highlights Report[2], by planning group members and the public during CBRWPG meetings, and water quality studies conducted for water management strategies included in previous and current Plans and other regional studies. The Coastal Bend Region identified water quality parameters for recommended water management strategies, as shown in Figure 6.1 and Figure 6.2.

The major impacts of recommended WMS on these key parameters of water quality are described in greater detail in the respective water management strategy summary (Chapter 5D). These identified water quality concerns may present challenges that would need to be overcome before the WMS can be implemented as a water supply. For water quality parameters that cannot be fully addressed due to lack of available information or inconclusive water quality studies, the WMS write-ups in Chapter 5D include recommendations for further studies prior to implementation as a WMS.

[2] Nueces River Authority, "2019 Program Update for San Antonio- Nueces Coastal Basin, Nueces River Basin, Nueces-Rio Grande Coastal Basin, and Bays and Estuaries" for the Texas Clean Rivers Program.

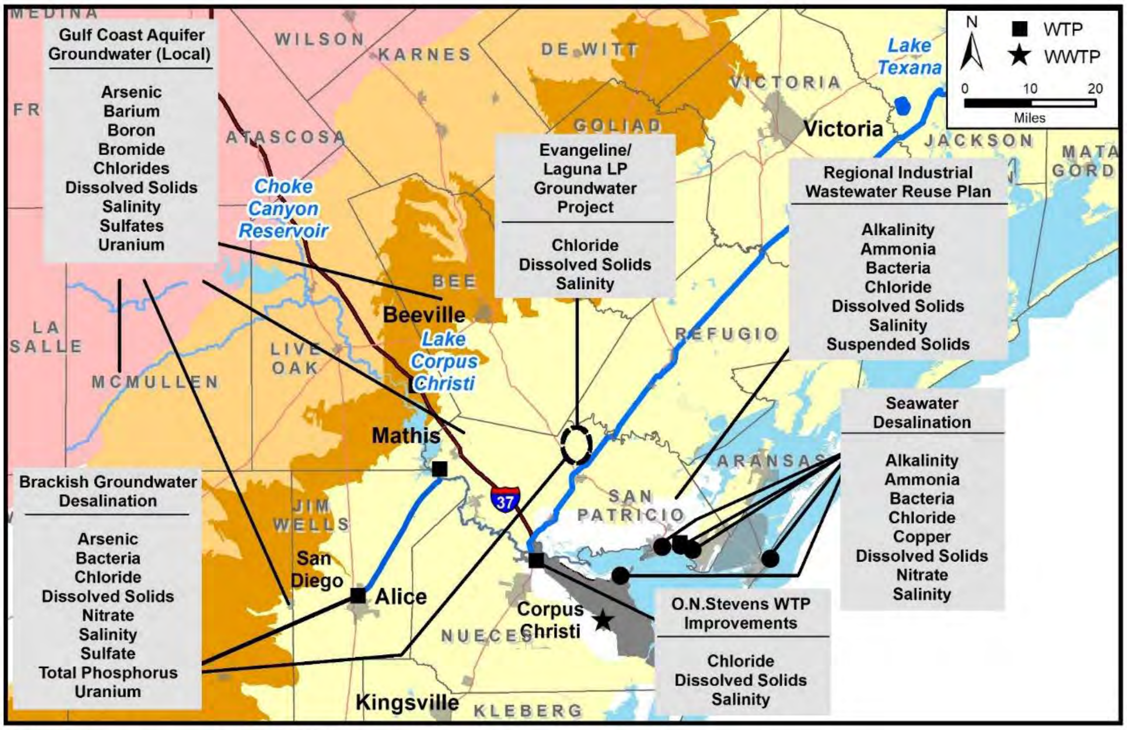

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Figure 6.1.
Water Quality Parameters to Consider for Water Management Strategies (1 of 2)

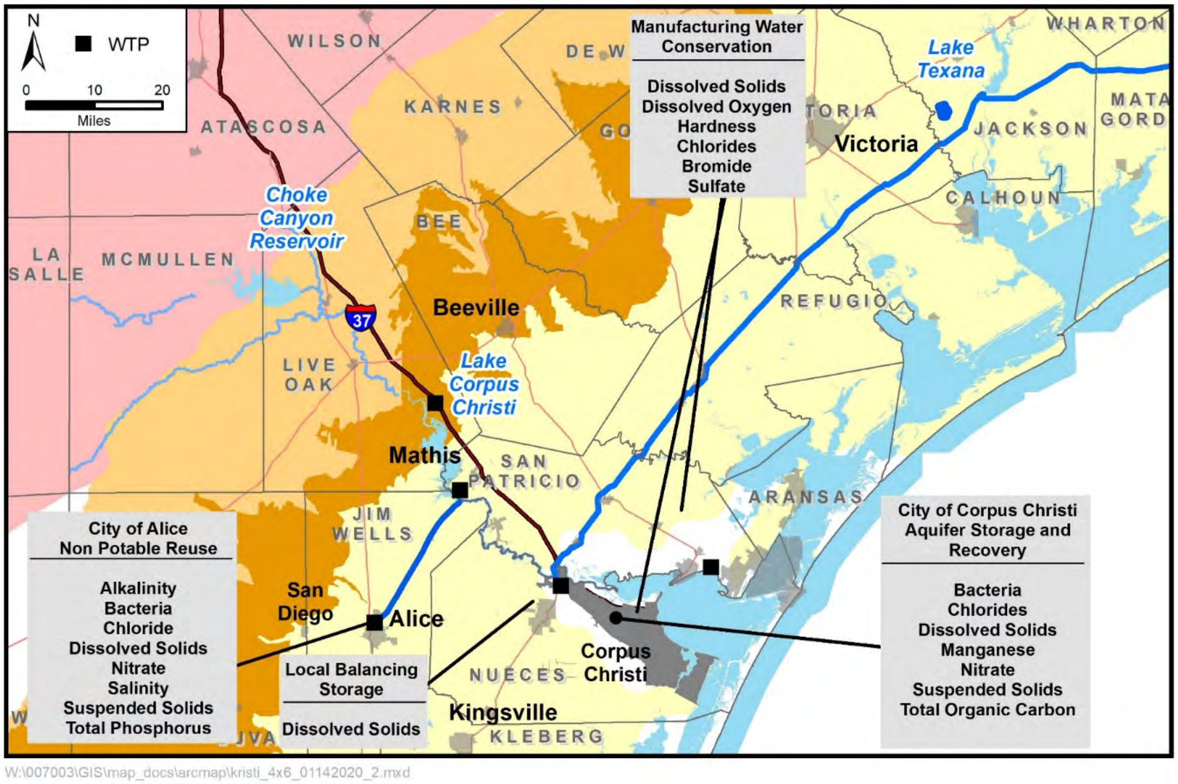

Figure 6.2.
Water Quality Parameters to Consider for Water Management Strategies (2 of 2)

6.7 Effects on Navigation

The water management strategies recommended to meet water needs are not anticipated to impact navigation. However, this consideration is evaluated for each water management strategy and included in the summary table at the end of each WMS description (Chapter 5D).

6.8 Summary of Identified Water Needs that Remain Unmet by the RWP

There are no identified water needs that remain unmet for the 2021 Regional Water Plan.

6.9 Interbasin Transfers

A number of interbasin transfer permits exist in the Coastal Bend Regional Planning Area. These permits include authorizations for diversions from river basins north of the planning region into the Nueces River Basin. Both major interbasin transfer permits provide water to the City of Corpus Christi and include supplies from the Lavaca-Navidad and Colorado River Basins. The City of

Corpus Christi benefits from an inter-basin transfer permit[3] and a contract with the LNRA to divert 31,440 ac-ft/yr on a firm basis and up to 12,000 ac-ft/yr on an interruptible basis from Lake Texana in the Lavaca-Navidad River Basin to the City's O.N. Stevens Water Treatment Plant.[4] This water is delivered to the City via the Mary Rhodes Pipeline (MRP), which became operational in 1998. In addition, the pipeline delivers MRP Phase II supplies from the Colorado River to the City through a second interbasin transfer permit owned by the City of Corpus Christi. This permit[5] allows the diversion of up to 35,000 ac-ft/yr of run-of-river water on the Colorado River. Analyses of this water right, one of the most senior in the Colorado River Basin, indicate that the 35,000 ac-ft/yr is available from this run-of-river right during the Nueces Basin drought of record when integrated as part of the Corpus Christi Regional Water Supply System.

6.10 Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources

The 2021 Coastal Bend Regional Water Plan (2021 Plan) is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources and is developed based on guidance principles outlined in the Texas Administrative Code Chapter 358 - State Water Planning Guidelines. The 2021 Plan was produced with an understanding of the importance of orderly development, management, and conservation of water resources and is consistent with all laws applicable to water use for the state and regional water planning areas. Furthermore, the plan was developed according to principles governing surface water and groundwater rights. The 2001 TCEQ Agreed Order governing freshwater pass-throughs to the Nueces Estuary was strictly adhered to for current surface water supply projects and future water management strategies. For groundwater, the 2021 Plan also recognized principles for groundwater use in Texas and the authority of groundwater conservation districts and groundwater management areas within the Coastal Bend Region. The modeled available groundwater (MAG) estimates developed by the TWDB based on desired future conditions developed by groundwater conservation districts and groundwater management areas was used to determine groundwater availability. The CBRWPG recognizes the need to protect groundwater quality.

The 2021 Plan identifies actions and policies necessary to meet the Coastal Bend Region's near and long-term water needs by developing and recommending water management strategies to meet their needs with reasonable cost, good water quality, and sufficient protection of agricultural and natural resources of the state. The Coastal Bend Region recommended water management strategies that considered public interest of the state, wholesale water providers, protection of existing water rights, and opportunities that encourage voluntary transfers of water resources while balancing economic, social, and ecological viability.

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[3] TCEQ, Certificate of Adjudication No. 16-2095C, held by Lavaca-Navidad River Authority and Texas Water Development Board (TWDB), October 21, 1996.
[4] A call-back of 10,400 ac-ft/yr has been exercised by the LNRA for water needs in Jackson County.
[5] TCEQ, Certificate of Adjudication No. 14-5434B, held by the City of Corpus Christi (via the Garwood Irrigation Company), October 13, 1998.

The 2021 Plan considered environmental information resulting from site-specific studies and ongoing water development projects when evaluating water management strategies. Water management strategies that have the potential of impacting instream flows and inflows to bay and estuary systems are discussed in the respective Chapter 5D subchapter. For the 2021 Plan, recommended water management strategies either originate from the Gulf of Mexico or groundwater projects that are expected to have minimal to no cumulative adverse effect on Nueces River instream flows and inflows to the Nueces estuary. Possible habitats for endangered and threatened species were considered for each water management strategy (Section 5D). The 2001 Agreed Order includes operational procedures for CCR and LCC and requires passage of inflows to the Nueces Bay and Estuary based on maximum harvest studies and inflow recommendations to maintain the health of the Nueces Estuary. It is likely that with additional water supplies from Lake Texana and the Colorado River from adjacent basins, water stored in CCR and LCC is at a higher percent storage capacity than what would have occurred if CCR and LCC were solely responsible for meeting the needs of the City of Corpus Christi and its customers at the same demand. The water supply diversification that has occurred in the region has aided to promote recreational uses at the lakes while meeting 2001 Agreed Order provisions for instream flow to the bay and estuary.

Due to most areas having an underlying impervious clay layer, there has not been much opportunity for springs to form in the Coastal Bend Region.

The 2021 Plan consists of initiatives to respond to drought conditions and includes drought contingency measures by regional entities (Chapter 7). Average annual inflows to Lake Corpus Christi and Choke Canyon System continue to trend lower with each successive drought, with the most recent hydrology update[1] for the Corpus Christi Water Supply Model (through 2015) showing a *new* drought of record for the Corpus Christi Regional Water Supply System from 2007 to 2013.The single lowest inflow year to the Lake Corpus Christi/ Choke Canyon Reservoir system occurred in 2011. The minimum 2 year (twenty four month) inflow to the LCC/CCR system during this most recent decade occurred from October 2010 to September 2012 at an inflow of 124,000 acft, which is 32% less than the minimum 2 year inflow to the LCC/CCR system in the 1990's of 183,000 acft that occurred from August 1994 to July 1996 and was the driver of the previous drought of record as seen in Figure 6.3. During other times, such as in the 1970s and intermittent periods not shown on the figure, inflows to the system are high. These natural, cyclical patterns are important to restore water storage as well as provide important pulses to maintain sediment transport and nutrients for bay and estuary health.

[1] City of Corpus Christi, Corpus Christi Water Supply Yield Results from Hydrology Update, June 1, 2017.

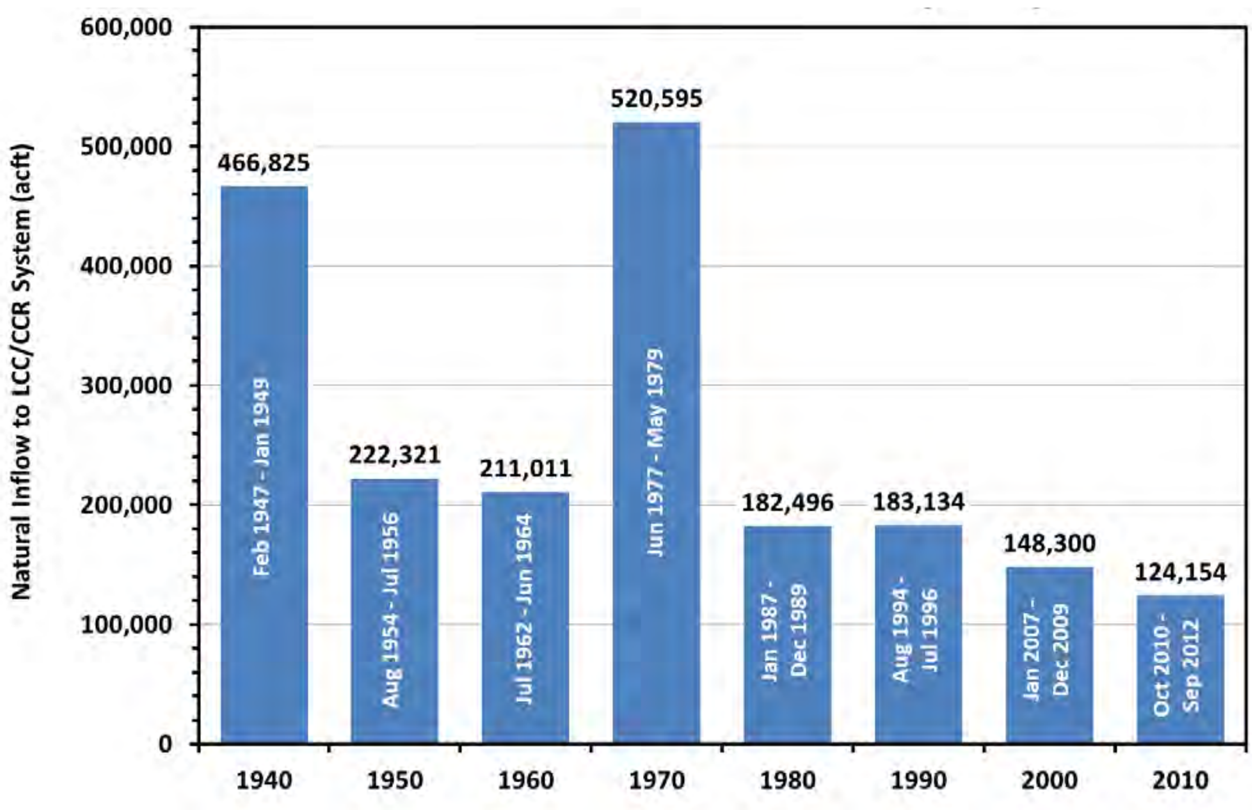

Figure 6.3.
Minimum 24-Month Natural Inflow to LCC/CCR System by Decade

The Coastal Bend Region conducted numerous meetings during the 2021 planning cycle, with meetings open to the public and decisions based on accurate, objective, and reliable information. The Region coordinated water planning and management activities with local, regional, State and Federal agencies and participated in interregional communication with the South Central Texas Region (Region L) and Lavaca Region (Region P) when needed to develop interregional strategies in an open, equitable, and efficient manner. The Coastal Bend Region considered recommendations of stream segments with unique ecological value by Texas Parks and Wildlife and sites of unique value for reservoirs. At this time, the Coastal Bend Region recommends that no stream segments with unique ecological value be designated. The Planning Group developed policy recommendations for the 2021 Plan including protection of water quality, consideration of environmental issues, interbasin transfers, groundwater management, request for additional studies for water supply projects (such as desalination), and continued funding for regional water planning efforts. The CBRWPG's policy recommendations are included in Chapter 8.

7

Drought Response Information, Activities, and Recommendations

[31 TAC §357.42]

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Chapter 7: Drought Response Information, Activities, and Recommendations

Droughts are of great importance to the planning and management of water resources in Texas. Although droughts can occur in all climatic zones, they have the greatest potential for environmental and public health concern in arid regions such as Texas. It is not uncommon for mild droughts to occur over short periods of time in the state, however, there is no reliable way to fully predict how long or severe a drought will be until it is over. The best defense available to WUGs in drought prone areas, such as those in Region N, is proper planning and preparation for worst case scenarios with contingencies for drought uncertainty. This requires understanding of drought patterns and the historical droughts in the region.

With population growth expected to continue in the Region N area based on TWDB projections, the demand for water will continue to increase. This growing demand compounded by climate uncertainty and extended drought periods makes planning even more important to prevent shortages, deterioration of water quality and lifestyle/financial impacts on water suppliers and users. This chapter presents information on Region N's drought preparedness, including regional droughts of record, current model drought contingency plans, emergency interconnects, and responses to local drought conditions.

Texas Administrative Code Chapter 357.42 presents guidance for drought and emergency response information for inclusion in the Regional Water Plans. A drought template provided by the TWDB in April 2019 included guidance on drought information to include in 2021 Regional Water Plans, which the CBRWPG considered during development of this chapter.

7.1 Droughts of Record in the RWPA

7.1.1 Background

One of the best tools in drought preparedness is a thorough understanding of the drought of record (DOR), or the worst drought to occur for a particular area during the available period of record. However, there are many ways that the "worst drought" can be defined (degree of dryness, agricultural impacts, socioeconomic impacts, effects of precipitation, etc.). Regional planning focuses on the hydrological drought or the drought with the largest shortfalls on surface and/or subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale, although it could be different from one area to the next, even within a planning region.

7.1.2 Current Drought of Record

The Corpus Christi Water Supply Model is used to determine water supply availability for the four basin regional CCR/LCC/Texana/MRP Phase II system (or Corpus Christi Regional Water Supply System). Prior to the 2021 Region N Plan, the 1992-2002 drought was used to define water availability. The 2016 Plan considered the recent drought beginning in 2007 as potentially being a new drought of record, but was not able to confirm that assumption because the Corpus Christi Water Supply Model did not include hydrology past 2003.

With the Corpus Christi Water Supply Model updated during this planning cycle to include recent hydrology through 2015, the new drought of record was confirmed. In terms of severity and duration, the drought from 2007-2013 is considered to be a new DOR for the Region N planning area. Although the LCC/CCR system has not yet returned to full capacity, rainfall events in October 2013 and June 2015 ameliorated the severity of drought during this time and replenished stored water levels. The combined CCR/LCC system has not been full since September 2007 and system storage as of February 2020 is approximately 52%, hence, it is important to understand that estimates of firm or safe yield reported herein represent maximum values.

The critical drawdown was 73 months from October 2007 to October 2013 during which time the reservoirs went from full to a minimum storage of 32.6% before inflows restored lake storage. From 2010-2012, inflows into LCC and CCR were 32% less (or 59,000 ac-ft less) than the inflows from 1994-1996 into LCC and CCR. For additional comparison, the 2010-2012 inflows were almost 50% less (or 98,200 ac-ft less) than the inflow into LCC and CCR from 1954-1956. Annual inflow to the CCR/LCC System for the model period from 1934 to 2015 is shown in Figure 7.1. The 3-year moving average shows the severity and duration of the recent drought relative to other droughts since the 1930s, and includes the recovery in 2013 and 2015.

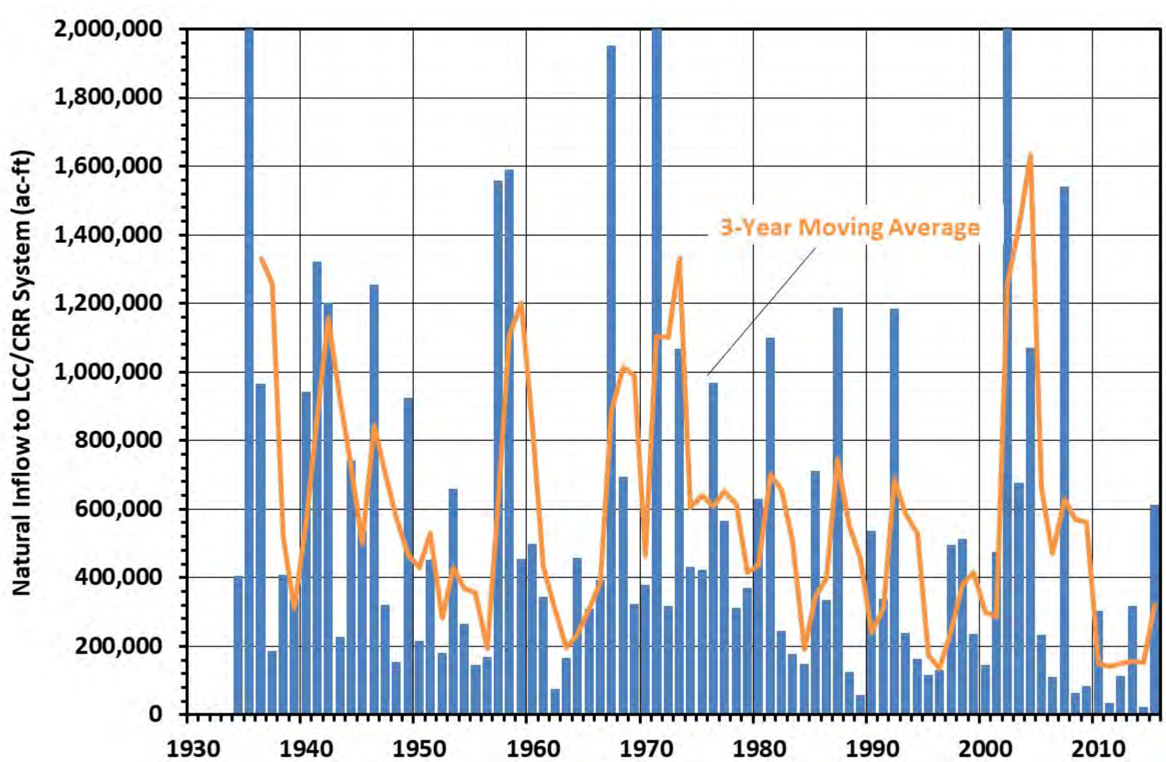

Figure 7.1.
Annual Natural Inflow to the CCR/LCC System

A large amount of water supplied to the region is provided by Lake Texana in Region P and the Colorado River (Mary Rhodes Phase II) in Region K which helps mitigate drought impacts in the Nueces Basin. For example, on September 27, 2013, while the combined storage in Choke Canyon Reservoir and Lake Corpus Christi was at 33% of capacity, storage in Lake Texana was at 81.9% of capacity. Often, drought occurs at different times and at different levels of severity in the Nueces, Lavaca-Navidad, and Colorado River basins. This frequent situation gives the City flexibility in operating the CCR/LCC/Texana/MRP Phase II system to optimize water supplies[1]. The DOR for the Lavaca-Navidad and Colorado River basins are December 1952 to April 1957 and October 2007 to April 2015, respectively.[2]

7.1.3 Corpus Christi Water Supply Model

Engineers and planners often use surface water models to demonstrate the effects of historical droughts on water supply. Surface water effects are more readily observed than groundwater; and, although reservoirs were not yet constructed before historic droughts, they can be simulated and assessed using historical hydrology. The main tool used to assess the performance of Region N reservoirs under historic drought conditions is the Corpus Christi Water Supply Model (CCWSM). This model simulates operations of the CCR/LCC/Texana/MRP Phase II system in addition to adhering to the pass-through schedule from the 2001 Agreed Order between the City and TCEQ governing freshwater inflows to the Nueces Estuary. Actual pass-through information can be accessed from the Nueces River Authority website[3].

During development of the 2021 Region N Plan, the Corpus Christi Water Supply Model was updated to include:

- Recent hydrology through 2015 to include the most recent drought of record for a total model period of 82 years (1934 to 2015), including extensions to net evaporation and ungaged runoff below LCC using methods consistent with the previous model version (1934 to 2003);
- New TWDB volumetric survey data for Lake Corpus Christi (2016), Choke Canyon Reservoir (2012), and Lake Texana (2010) with updated sediment accumulation rates;
- Recent hydrology for Lake Texana and the Colorado River (for Mary Rhodes Phase II supplies) through 2015;
- Verification that all enhancements adhere to the provisions of the TCEQ 2001 Agreed Order;
- Lake Texana callback of 10,400 ac-ft/yr as exercised by LNRA for local water users in Jackson County pursuant to City of Corpus Christi contract terms; and

[1] Subject to permitted or contracted supply amounts.
[2] https://www.lcra.org/download/2020-water-management-plan/?wpdmdl=11923 p. 3-2
[3] https://www.nueces-ra.org/CP/CITY/passthru/index.php

- Operational flexibility to exercise water supply calls on the Colorado River-Garwood water right at a variable rate according to diversion rate and priority date of the rights and based on MRP Phase II system capacities.

At the August 10, 2017 CBRWPG meeting, the planning group considered guidance from the TWDB to consider firm yield when determining surface water availability as well the Region N approach that had been taken in previous planning cycles to determine availability based on safe yield. The Corpus Christi Water Supply Model was used to estimate firm yield of the system for 2020 and 2070 sediment conditions, which is the maximum amount of water volume that can be provided under a repeat of drought of record conditions assuming that all senior water rights will be totally utilized and all permit conditions met. In this case, this is the yield that would be available such that reservoir active storage would be equal to zero during the worst month of the drought of record. Figure 7.2 shows a storage trace for the LCC/CCR system under a hypothetical 2020 firm yield demand of 194,000 ac-ft/yr. The critical month of the DOR is September 2013.

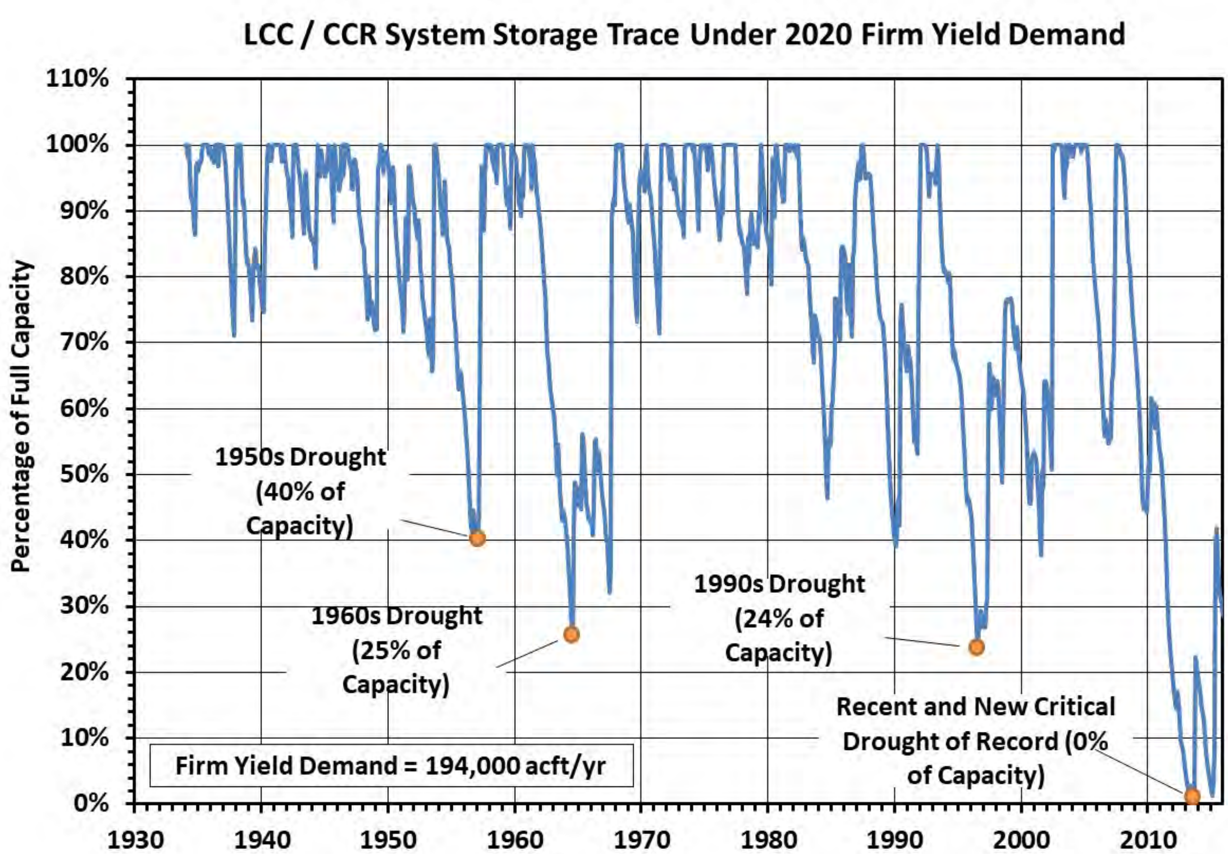

Figure 7.2.
CCR/LCC System Storage Trace- 2020 Firm Yield of 194,000 ac-ft/yr

During the meeting, the Coastal Bend Regional Water Planning Group decided to limit supply availability for the CCR/LCC/Texana/MRP Phase II System based on safe yield to maintain a reserve in storage during the worst, historical drought of record that occurred from 2007 to (at least) 2013. Safe yield is a standard approach that the CBRWPG and City of Corpus Christi have consistently used in previous planning cycles as a provision for climate and growth uncertainty, such that a *specified reserve amount remains* in storage during the modeled critical drought. Based on a presentation by the City of Corpus Christi and additional information at the November 9, 2017 meeting, the CBRWPG approved submittal of a hydrologic variance request to use safe yield with 75,000 ac-ft reserve in the CCR/LCC system for determining surface water supplies available from the City's Regional Water Supply System, which was subsequently granted by the TWDB on January 5, 2018. Figure 7.3 shows a storage trace for the LCC/CCR system similar to Figure 7.2 except that a 75,000 ac-ft reserve is maintained during the critical month of the DOR (September 2013) resulting in a 2020 safe yield of 178,000 ac-ft/yr. This safe yield supply from the City's Regional Water Supply System is the basis of the needs analysis of this plan for entities relying on surface water supplies from the City of Corpus Christi, SPMWD, and STWA. The safe yield maintains the 75,000 ac-ft reserve through the planning period (2020-2070) and declines to 167,000 ac-ft/yr by 2070 due to sedimentation.

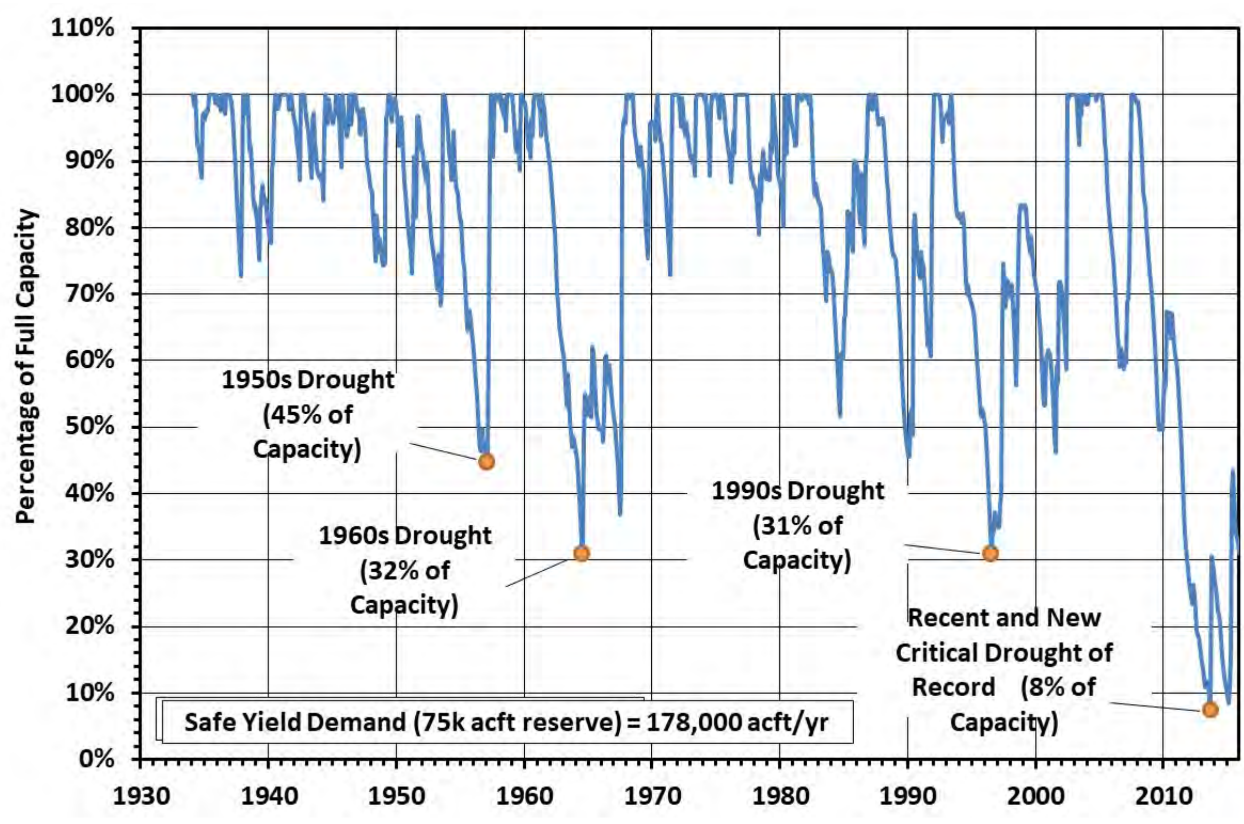

Figure 7.3.
CCR/LCC System Storage Trace- 2020 Safe Yield of 178,000 ac-ft/yr

7.2 Current Drought Preparations and Response

7.2.1 Current Drought Preparations and Responses WUG Level Planning

Water User Groups in Region N prepare for drought by implementing their drought contingency plans and participating in planning discussions. The regional planning process attempts to meet projected water demands during a drought of equal severity to the DOR. WUGs that provide accurate information to the Texas Water Development Board and consider recommendations accepted by the regional planning group should be able to supply water to customers throughout drought periods. In addition, all wholesale Water Providers and most municipalities develop individual drought contingency plans (DCPs) or emergency action plans to be implemented at various stages of a Drought.

7.2.2 Overall Assessment of Local Drought Contingency Plans

While it's impossible to predict the timing, severity and length of a drought, it is an inevitable component of water supply planning in Texas. For this reason, it is critical to plan for these occurrences with policy outlining adjustments to the use, allocation and conservation in response to drought conditions. Drought and other circumstances threaten interruption of supply or water quality of a source, potentially leading to water shortages. When water shortages occur there is generally a greater demand on the already decreased supply as individuals may attempt to keep lawns green. In the twenty months from June 2013 to February 2015 coinciding with the DOR when once a week watering was implemented, the residential water use was reduced by 18% (or total of 5-6% for all users).[4] This behavior reduces the rate of water supply depletion during drought.

TCEQ requires all wholesale public water suppliers, retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans (DCPs). In accordance with the requirements of Texas Administrative Code §288(b), DCPs must be updated every 5 years and adopted by retail public water providers. The TCEQ defines a DCP as "A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies." [5] According to the TCEQ handbook for drought contingency[6], the underlying philosophy of drought contingency planning is that:

- While often unpreventable, short-term water shortages and other water supply emergencies can be anticipated;

[4] Email correspondence from Brent Clayton, March 2015.
[5] http://www.twdb.texas.gov/conservation/training/archives/more-than-a-drop-workshop/doc/5_%20TCEQ%20Rules.pdf.
[6] https://www.rcac.org/wp-content/uploads/2015/08/TX_Drought_Planning_Handbook_2014.pdf.

- The potential risks and impacts of drought or other emergency conditions can be considered and evaluated in advance of an actual event; and, most importantly

- Response measures and best management practices can be pre-determined with implementation procedures defined, again in advance, to avoid, minimize, or mitigate the risks and impacts of drought-related shortages and other emergencies.

Example Drought Contingency plans are available on TCEQ's website; however, it is not possible to create a single DCP model that will adequately address local concerns throughout the State of Texas. The conditions that define a water shortage are location specific and may vary for water users that use groundwater versus surface water or those that have sole-source of supply versus those with a multiple source, diversified water system. While the approach to planning may be different between entities, all DCPs should include:

- Specific, quantified targets for water use reductions,
- Drought response stages,
- Triggers to begin and end each stage,
- Supply management measures,
- Demand management measures,
- Descriptions of drought indicators,
- Notification procedures,
- Enforcement procedures,
- Procedures for granting exceptions,
- Public input to the plan,
- Ongoing public education,
- Adoption of plan, and
- Coordination with regional water planning group.

For water suppliers, the primary goal of DCP development is to have a plan that can reliably provide an uninterrupted supply of water in an amount that can satisfy essential human needs. A secondary, but also important, goal is to minimize negative impacts on quality of life, the economy, and the local environment. In order to meet these goals, action needs to be taken quickly which is why an approved DCP needs to be in place before drought conditions occur.

In accordance with Texas Administrative Code, most Region N entities have submitted DCPs to be implemented during drought conditions. Region N was able to obtain DCPs from all four wholesale water providers, the LNRA, and 27 municipal WUGs and county-other entities as seen in Table 7.1. These plans identify multiple triggers for initiation and termination of drought stages, responses to be implemented and reduction targets based on each stage. The plans also include information regarding public notification procedures and enforcement measures. Some WUGs or WWPs have included a method of granting a variance should the need arise. The most recent DCPs for each entity in Region N range in date from 2000 to 2020. The Texas Water Code Chapter 11 and TAC Chapter 288 requires retail public water suppliers with 3,300 or more connections, irrigation water providers, and wholesale public water suppliers to develop, implement, and submit updated DCPs to the TCEQ every five years. Detailed DCP information for the four wholesale water providers who supply water to the majority of WUGs in the region can be found in Tables 7.2 to 7.6.

Table 7.1.
Region N Entities with Available DCP

Region	County Name	WUG	DB22 EntityRwp Id	DCP on File	DCP Date
Wholesale Water Providers and Lavaca Navidad River Authority					
N	Nueces	Corpus Christi	32	x	2018
N	San Patricio & Nueces	SPMWD (San Patricio Municipal Water District)	119	x	2019
N	Kleberg	South Texas Water Authority	123	x	2018
N	Nueces	Nueces County WCID #3	104	x	2019
N	Jackson	LNRA	n/a	x	2014
Water User Groups					
N	Aransas	Aransas Pass	185	x	2008
N	Aransas	Rockport	2152	x	2013
N	Live Oak	Three Rivers	2369	x	2014
N	Bee	Beeville	222	x	2020
N	Bee	Pettus MUD	13190	x	2000
N	Brooks	Falfurrias	710	x	1999
N	Duval	Freer WCID	740	x	2000
N	Duval	San Diego MUD #1	2176	x	2000
N	Jim Wells	Alice	163	x	2019
N	Jim Wells	Orange Grove	2033	x	2000
N	Kleberg	Kingsville	1163	x	2002
N	Kleberg	Ricardo WSC	2126	x	2018
N	Kleberg	Riviera WSC	13216	x	2000
N	Live Oak	El Oso WSC	4104	x	2009
N	Live Oak	McCoy WSC	4250	x	2000
N	Nueces	Nueces WSC	2871	x	2019
N	Nueces	River Acres WSC	2141	x	2000
N	San Patricio	Odem	2024	x	2013
N	San Patricio	Ingleside	874	x	2018
N	San Patricio	Taft	2349	x	2013
N	San Patricio	Portland	2093	x	2013
N	San Patricio	Rincon WSC	2846	x	2009
County-Other Entities					
N	Aransas	Aransas County MUD #1	n/a	x	2009
N	Bee	Blueberry Hills	n/a	x	2005
N	Aransas	Copano Heights Water Company	n/a	x	2018
N	Hidalgo	Escondido Creek Estates	n/a	x	2000
N	McMullen	McMullen County WCID #2	n/a	x	2002
N	Kleberg	Baffin Bay WSC	n/a	x	2015

Table 7.2.
City of Corpus Christi Surface Water Sources Drought Contingency Response

Drought Contingency Stage	Reservoir System Storage	Actions
Stage I – Mild	*Less than 40%	• Target treated water demand reduction of 10 percent, including for wholesale water contracts. • City Manager issues a public notice implementing required water conservation measures. • More repair crews will be used if necessary to repair leaks. • Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to once per week based on the City Manager's watering schedule. • Fire hydrant use is restricted to the interest of public health and safety. • Prohibits use of water for Golf Course irrigation to designated water days unless the course uses a source other than Corpus Christi Utilities. • Use of water to maintain integrity of building foundations is limited to watering days and hand held hose or drip irrigation.
Stage II – Moderate	*Less than 30%	In addition to Actions under Stage I, take the following actions: • Target water demand reduction of 20 percent, including for wholesale water contracts • Flushing of water mains is eliminated unless in interest of public safety. • Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to once every other week. • The watering of golf course fairways with potable water is prohibited
Stage III – Critical	*Less than 20%	In addition to Actions under Stage II, take the following actions: • Target water demand reduction of 30 percent, including for wholesale water contracts • Irrigation of landscaped areas shall be prohibited at all times. • Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle not occurring on the premises of a commercial car wash and not in the immediate interest of public health, safety, and welfare is prohibited. • The filling, refilling, or adding of water to swimming pools, wading pools, and jacuzzi-type pools, and water parks (unless utilizing water from a non-city source) is prohibited. Fountains may operate to maintain equipment. • Optional: prohibit applications for water service facilities of any kind.
Stage IV – Emergency	Not applicable	In addition to Actions under Stage III, take the following actions: • Achieve a 50% or greater reduction in daily treated water demand relative to treated water demand. • Irrigation of landscaped area is absolutely prohibited. • Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle is absolutely prohibited. • Associated uses of water not related to business process which are discretionary, such as equipment washing, shall be deferred until the Stage 5 emergency has been terminated.

* CCR/LCC combined storage

** Other purposes include vehicle washing, indoor and outdoor pools, golf course irrigation, and use of water for the integrity of building foundations.

Table 7.3.
San Patricio Municipal Water District Drought Contingency Response

Drought Contingency Stage	Reservoir System Storage	Actions
Stage I – Mild	*less than 50% or if Lake Texana is less than 40%	• District Manager issues a public notice to inform water users of the Corpus Christi water supply region to begin voluntary conservation measures. • Target water demand reduction of 5 percent, including for wholesale water contracts. • All operations of the District shall adhere to water use restrictions prescribed for Stage 2 of the DCP
Stage II – Moderate	*Less than 40%	• District Manager issues a public notice implementing required water conservation measures. • Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to once per week. • District Manager issues a lawn watering schedule and designates watering days and specific exemptions for **other purposes. • Prohibits use of water to wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas, except if it is in the interest of public health and safety. • Prohibits use of water to wash down buildings or structures for purposes other than immediate fire protection without permit granted by the District Manager. • Prohibits use of water for dust control without permit granted by the District Manager. • Target water demand reduction of 10 percent, including for wholesale water contracts.
Stage III – Severe	*Equal to or less than 30%	In addition to Actions under Stage II, take the following actions: • Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to once every other week. • The watering of golf course fairways with potable water is prohibited. • Target water demand reduction of 15 percent, including for wholesale water contracts.
Stage IV – Critical	*Equal to or less than 20%	• Irrigation of landscaped areas shall be prohibited at all times. • Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle not occurring on the premises of a commercial car wash and not in the immediate interest of public health, safety, and welfare is prohibited. • The filling, refilling, or adding of water to swimming pools, wading pools, and jacuzzi-type pools, and water parks (unless utilizing water from a non-city alternative source) is prohibited. • The use of water to maintain the integrity of a building foundation is permitted on the designated watering day and shall be done by hand or drip irrigation method. • Target water demand reduction of 30 percent, including for wholesale water contracts.

* CCR/LCC combined storage

** Other purposes include vehicle washing, indoor and outdoor pools, golf course irrigation, and use of water for the integrity of building foundations.

Table 7.4.
South Texas Water Authority Drought Contingency Response

Drought Contingency Stage	Reservoir System Storage	Actions
Stage I – Mild Water Shortage Conditions	*Less than 40%	1. Notify all its wholesale water customers regarding the initiation of the drought response stage. 2. Provide reports to the City of Corpus Christi with information regarding current wholesale customer usage. 3. Initiate preparations for the implementation of pro rata curtailment of water diversions and/or deliveries by preparing a monthly water usage allocation baseline for each wholesale customer. 4. Contact wholesale water customers to discuss water supply and/or demand conditions and request that wholesale water customers initiate voluntary measures to reduce water use. 5. Request wholesale customers and assist in the effort to organize a committee of business, industrial, and residential representatives to make recommendations for the necessary regulations and prohibitions. 6. Provide a report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices. 7. Target water demand reduction of 10 percent.
Stage II – Moderate Water Shortage Conditions	*Less than 30%	In addition to Actions 1-3 under Stage I, take the following actions: 8. Request wholesale customers continue with conditions set during Stage I. In addition, request that wholesale customers consider implementation of additional regulations and prohibitions. 9. Contact with wholesale water customers to discuss water supply and/or demand conditions and the possibility of pro rata curtailment of water diversion and/or deliveries. 10. Request wholesale water customers to initiate mandatory measures to reduce non-essential water use. 11. Target water demand reduction of 15 percent.
Stage III – Severe Water Shortage Conditions	*Less than 20%	12. Request wholesale customers continue with conditions set during Stage II. In addition, request that wholesale customers consider implementation of additional regulations and prohibitions. 13. Provide reports to the City of Corpus Christi with information regarding current wholesale customer usage. 14. Target water demand reduction of 30 percent.
Stage IV – Critical Water Shortage Conditions	Not applicable	15. Request wholesale customers continue with conditions set during Stage III. In addition, request that wholesale customers consider implementation of additional regulations and prohibitions. 16. Provide reports to the City of Corpus Christi with information regarding current wholesale customer usage. 17. Target water demand reduction of 50 percent.

*Corpus Christi/Choke Canyon Reservoirs (CCR/LCC) combined storage

Table 7.5.
Nueces County WCID #3 Drought Contingency Response

Drought Contingency Stage	Reservoir System Storage	Actions
Stage I – Water Shortage Possibility	Water in the reservoirs is less than 40% of total storage capacity	• The District will notify all its customers regarding the initiation of the drought response stage. • Target water demand reduction of 10%, preferable during times of peak use. • Agricultural irrigation shall be limited to twice per week. • Stage 1 Drought Condition Water Rates may be initiated.
Stage II – Water Shortage Watch	Water in the reservoirs is less than 30% storage capacity	• The District will notify all its customers regarding the initiation of the drought response stage. • Target water demand reduction of 20%, preferable during times of peak use. • Use of water to wash motor vehicle, boat, trailers, other vehicles, refilling swimming pools is prohibited except on designated watering days. Operation of ornamental ponds is prohibited. • Use of water from hydrants should be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the District. • The district will discontinue routine flushing of water mains. • Agricultural irrigation shall be limited to twice per week. • Stage 2 Drought Condition Water Rates may be initiated by the District Manager and Board of Directors.
Stage III – Water Shortage Warning	Water in the reservoirs is less than 20% of total storage capacity	• The District will notify all its customers regarding the initiation of the drought response stage. • Target water demand reduction of 30%, preferable during times of peak use. • All Stage II provisions will be enforced. • New service connections to the District's water system may be prohibited where some other source independent of the District's water system is existing and in use. • The use of potable water for watering golf course tees is prohibited. • The use of water for construction purposes from designated fire hydrants under special permit may be discontinued. • Agricultural irrigation shall be limited to designated watering days. The use of hose-end sprinklers is prohibited at all times. • Stage 3 Drought Condition Water Rates may be initiated.
Stage IV – Water Shortage Emergency	Major line break, pump or system failure, water production or distribution limitations, contamination of water supply	• The District will notify all its customers regarding the initiation of the drought response stage. • Target water demand reduction of 50%, preferable during times of peak use. • All requirements of Stage 1, 2, and 3 shall remain in effect. • Use of water to wash motor vehicle, boat, trailers, other vehicles, and refilling swimming pools is prohibited. • Agricultural irrigation water will be eliminated. • Associated uses of water not related to business process which are discretionary, such as equipment washing, shall be deferred until Stage 5 is terminated.

Table 7.6.
Lavaca Navidad River Authority's Drought Contingency Response

Drought Condition	Trigger	Actions
Condition I – Mild Water Shortage Condition	Lake Texana Reservoir elevation is at or below elevation 43.00 ft msl	1. LRNA will notify TCEQ Watermaster of reservoir condition. 2. Inform public, giving notice of reservoir condition to the customers served by the LNRA system and upstream water rights permit holders. 3. *Impacts permit holders upstream of Lake Texana who divert water for irrigation purposes.* Diversions must cease within 24 hours following the time when the reservoir level drops below elevation 43.00 ft msl.
Condition II – Moderate Water Shortage Condition	Lake Texana Reservoir elevation is at or below elevation 39.95 ft msl	In addition to Actions 1–3 under Conditions I, take the following actions 4. *Impacts freshwater releases to bays and estuaries.* LNRA may reduce the volume of freshwater releases to bays and estuaries to 5 cubic feet per second, when Lake Texana reaches roughly 78% of the reservoir capacity. 5. Target water demand reduction of 5 percent of the use that would have occurred in the absence of drought contingency measures. 6. Notify TPWD of reservoir condition and change in B&E release schedule. 7. Include recommendations to conserve water in information to the public.
Condition III – Severe Water Shortage Condition	Lake Texana Reservoir elevation is at or below elevation 35.00 ft msl Water supply emergency occurs or drought worse than the Drought of Record is declared	8. LRNA will notify TCEQ Watermaster and Dam Safety Team of reservoir condition. 9. Inform public, giving notice of reservoir condition and delivery volume. 10. Implement pro rata reduction of water deliveries to industrial and municipal customers. 11. Through the news media, the public should be advised daily of the trigger conditions, the mandatory reduction, and that water users conserve water.
Condition IV – Critical Water Shortage Condition	Contamination of water supply source Failure or damage to the operating structures due to a natural or catastrophic event Water supply emergency occurs or drought worse than the Drought of Record is declared	12. LRNA will notify TCEQ Watermaster and Dam Safety Team of reservoir condition. 13. Inform public, giving notice of reservoir condition and delivery volume. 14. Implement pro rata reduction of water deliveries to industrial and municipal customers. 15. Through the news media, the public should be advised daily of the trigger conditions, the mandatory reduction, and that water users conserve water.

7.2.3 Summary of Existing Triggers and Responses

Through timely implementation of drought response measures, it is possible to meet the goals of the DCP by avoiding, minimizing or mitigating risks and impacts of water shortages and Drought. In order to accomplish this, DCPs are built around a collection of drought responses and triggers based on various drought stages. Inclusion of stages is typical of all DCP's, but stage definition can vary from entity to entity. Stage one will normally represent mild water shortage conditions and the severity of the situation will increase through the stages until emergency water conditions are reached and, in some cases, a water allocation stage is defined.

The CBRWPG conducted an overall assessment of current preparations for drought within the Coastal Bend Region to determine how water suppliers in the region identify and respond to drought. Drought contingency plan information on stage, trigger and response for 31 DCPs in the region and LNRA was compiled, including those from WWPs, WUGs and County-Other suppliers. The majority of the DCPs in the region have voluntary Stage I and Mandatory Stage II and III categories. Most entities include a Stage IV and a few entities specify a Stage V scenario. Target reductions, triggers and responses are included for most stages. Triggers for individual Region N water user groups can be found in Table 7.7 and corresponding responses can be found in Table 7.8.

Table 7.7.
Region N DCP Drought Triggers

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Water User Groups						
City of Aransas Pass (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/AransasPass.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage falls below 50% of maximum capacity.	***Moderate Water Shortage Conditions*** When the LCC/CCR system storage falls below 40% of maximum capacity.	***Severe Water Shortage Conditions*** When the LCC/CCR system storage falls below 30% of maximum capacity.	***Critical Water Shortage Conditions*** When the LCC/CCR system storage falls below 15% of maximum capacity. Whenever there is an interruption in the City of Corpus Christi or SPMWD's raw water supply. When there is a mechanical breakdown in the City of Corpus Christi or SPMWD's WTP which causes plant shutdown for an extended period of time.	***Emergency Water Shortage Conditions*** When the City Council or their designee determines that a water supply emergency exists. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Rockport (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Rockport.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage falls below 50% of maximum capacity. OR Lake Texana storage declines below 40%	***Moderate Water Shortage Conditions*** When the LCC/CCR system storage falls below 40% of maximum capacity.	***Severe Water Shortage Conditions*** When the LCC/CCR system storage falls below 30% of maximum capacity.	***Critical Water Shortage Conditions*** When the LCC/CCR system storage falls below 20% of maximum capacity.	***Emergency Water Shortage Conditions*** When the City Council or their designee determines that a water supply emergency exists. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Water production or transmission system limitations. Natural or man-made contamination of the water supply source(s).
City of Three Rivers (Live Oak County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/3rivers.pdf	***SW***	***Mild Water Shortage Conditions*** When CCR storage falls below 50% of maximum capacity. OR City of Corpus Christi declares Stage 1 *OR* When there is high demand on the system.	***Moderate Water Shortage Conditions*** When CCR storage falls below 40% of maximum capacity. OR City of Corpus Christi declares Stage 2 *OR* When daily water demand exceeds 85% of capacity for 3 consecutive days.	***Severe Water Shortage Conditions*** When CCR storage falls below 30% of maximum capacity. OR City of Corpus Christi declares Stage 3 OR When daily water demand exceeds 90% of capacity for 3 consecutive days.	***Critical Water Shortage Conditions*** When CCR storage falls below 20% of maximum capacity. OR City of Corpus Christi declares Stage 4 OR When daily water demand exceeds 95% of capacity for 3 consecutive days.	***Emergency Water Shortage Conditions*** Major limitations to water system components, water productions or distribution limitations, or supply contamination.
City of Beeville (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/beeville_cp.pdf	***SW***	***Mild Water Shortage Condition*** Lake Levels less than40% and production from Chase Wells cannot meet system demand	***Moderate Water Shortage Condition*** Lake Levelsless than 30% and production from Chase Wells cannot meet system demands	***Severe Water Shortage Condition*** Lake Levels less than 20% and production from Chase Wells cannot meet system demands	***Emergency Water Shortage*** In the case of an emergency, contamination, or if water system fails to produce water	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Pettus MUD (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/PettusMUD.pdf	***GW***	***Mild Water Shortage Conditions*** Total exceeds daily water demand equals safe or operating 85% of capacity the for system's three consecutive days or equals or exceeds 90% of system capacity on a single day.	***Moderate Water Shortage Conditions*** Total daily water demand equals or exceeds 90% of the systems safe operating capacity for three consecu-tive days or equals or exceeds 95% of system capacity on a single day.	***Severe Water Shortage Conditions*** Total daily water demand equals or exceeds 95% of the systems safe operating capacity for three consecu-tive days or equals or exceeds 100% of system capacity on a single day.	***Critical Water Shortage Conditions*** Total daily water demand equals or exceeds 100% of the systems safe operating capacity for three consecu-tive days or equals or exceeds 100% of system capacity on a single day.	***Emergency Water Shortage Conditions*** Designee determines that a water supply emergency exists based on: Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to pro-vide water service. Natural or man-made contamination of the water supply source(s).
Falfurrias (Brooks County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Falfurrias_DCP_WCP_1999.pdf	***GW***	***Mild Water Shortage Conditions*** Static water level in the Falfurrias water wells equal to or below mean sea level OR specific capacity is equal to or less than 5% original specific capacity OR total daily water demand exceeds 2.5 MG for 10 days or 5 MG on a single day; OR falling treated reservoir levels that do not refill above 80% overnight	***Moderate Water Shortage Conditions*** Two or more triggering criteria listed for Stage 1 exist	***Severe Water Shortage Conditions*** Three or more triggering criteria listed for Stage 1 exist	***Critical Water Shortage Conditions*** Four or more triggering criteria listed for Stage 1 exist	***Emergency Water Shortage Conditions*** General manager or designee determines that a water supply emergency exists based on: Major water line breaks or Natural or man-made contamination of the water supply source(s).

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Freer WCID (Duval County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Freer.pdf	***GW***	***Mild Water Shortage Conditions (voluntary)*** Annually, beginning May 1 through September 1. When the static level in the Freer WCID is equal to or less than 10 feet above sea level. When the specific capacity of the Freer WCID wells are equal to or less than 70% of the well's original specific capacity. When total daily water demand equals or exceeds 700,000 gallons for 10 consecutive days or 700,000 gallons on a single day.	***Moderate Water Shortage Conditions*** When daily water demand total equals or exceeds 700,000 gallons for 10 consecutive days or 700,000 gallons on a single day.	***Severe Water Shortage Conditions*** When the specific capacity of the Freer WCID wells is equal to or less than 70% of the well's original specific capacity.	***Critical Water Shortage Conditions*** When the static water level in the Freer WCID wells is equal to or less than 10 feet above sea level.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service OR Natural or man-made contamination of the water supply source(s)

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
San Diego MUD #1 (Duval County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/SanDiego.pdf	***GW***	***Mild Water Shortage Conditions*** Annually, beginning on May 1 through October 31 of every year. When the water supply available to the San Diego Municipal Utility District No. 1 is equal or less than 70% of storage capacity. When the static water level in the San Diego Municipal Water Utility District No. 1 well(s) is equal or less than 100 feet above water pump level. When the specific capacity of the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 70% of the well's original specific capacity. When total daily water demands equal or exceed one million gallons for 3 consecutive days.	***Moderate Water Shortage Conditions*** Water levels fall below 70% of storage capacity. Water demands exceed 70% of water well capacity. When the static water level in the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 100 feet above water pumps.	***Severe Water Shortage Conditions*** Water levels fall below 50% of storage capacity. Water demands exceed 90% of water well capacity. When the static water level in the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 100 feet above water pumps. System outages due to equipment failure.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service OR Natural or man-made contamination of the water supply source(s).	
City of Alice (Jim Wells County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Alice_DCP_2019.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC water elevation is below 88 feet.	***Moderate Water Shortage Conditions*** When the LCC water elevation is below 86 feet.	***Severe Water Shortage Conditions*** When the LCC water elevation is below 82 feet.	***Critical Water Shortage Conditions*** When the LCC water elevation is below 74 feet.	***Emergency Water Shortage Conditions*** Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Natural or man-made contamination of water supply source(s).

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Orange Grove (Jim Wells County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/OrangeGrove.pdf	***GW***	***Mild Water Shortage Conditions (voluntary)*** When the static water level in City Water Well No. 4 is equal or more than 140 feet below the top of the casing. When total daily water demands equals or exceeds 90% of system safe operating capacity which is 750,000 gallons per day, for 10 consecutive days.	***Moderate Water Shortage Conditions*** When the static water level in City Water Well No. 4 drops to 150 feet below the top of the casing.	***Severe Water Shortage Conditions*** When the static water level in City Water Well No. 4 reaches 160 feet below the top of the casing.	***Critical Water Shortage Conditions*** When the static water level in City Water Well No. 4 reaches 165 feet below the top of the casing.	***Emergency Water Shortage Conditions*** Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Natural or man-made contamination of water supply source(s).
City of Kingsville (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Kingsville.pdf	***GW***	***Mild Water Shortage Conditions*** Capacity of groundwater wells less than= 90% capacity AND Total daily water demand exceeds 6 million gallons for 3 consecutive days	***Moderate Water Shortage Conditions*** Capacity of groundwater wells less than= 85% capacity AND Total daily water demand exceeds 7 million gallons for 3 consecutive days	***Severe Water Shortage Conditions*** Capacity of groundwater wells less than= 80% capacity AND Total daily water demand exceeds 7.5 million gallons for 3 consecutive days	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).	***Water Allocation*** City manager determines that water shortage conditions threaten public health, safety and welfare.
Ricardo WSC (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Ricardo.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage falls below 40% of combined level.	***Severe Water Shortage Conditions*** When the LCC/CCR system storage falls below 30% of combined level.	***Critical Water Shortage Conditions*** When the LCC/CCR system storage falls below 20% of combined level.	***Emergency Water Shortage Conditions*** When the City Council or their designee determines that a water supply emergency exists. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Water production or distribution system limitations. Natural or man-made contamination of the water supply source(s).	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Riviera Water System (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Riviera.pdf	***GW***	***Customer Awareness*** Every April 1st, the utility will mail a public announcement to its customers.	***Voluntary Water Conservation*** Overnight Recovery rate reaches 4 ft. 17 Pump hours per day.	***Mandatory Water Use Restrictions*** Overnight Recovery rate reaches 2 ft. 20 Pump hours per day.	***Critical Water Use Restrictions*** Overnight Recovery rate reaches 0 ft. 22 Pump hours per day.	
El Oso WSC (Service area includes 500 square miles located in Karnes, Bee, Wilson, and **Live Oak Counties**) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Eloso.pdf	***GW***	***Mild Water Shortage Conditions*** Well flow from any regularly used well is less than 90% of full capacity. A storage facility is not filled for 72 consecutive hours. An elevated storage tank is out of service due to repainting or other required maintenance.	***Moderate Water Shortage Conditions*** Well flow from any regularly used well is less than 80% of full capacity. A storage facility is not filled for 96 consecutive hours.	***Severe Water Shortage Conditions*** Well flow from any regularly used well is less than 70% of full capacity. A storage facility is not filled for 120 consecutive hours.	***Critical Water Shortage Conditions*** Well flow from any regularly used well is less than 60% of full capacity. A storage facility is not filled for 144 consecutive hours.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).
McCoy WSC (Service area includes 608 square miles located in Atascosa, Wilson, and **Live Oak Counties**) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/McCoy.pdf	***GW***	***Mild Water Shortage Conditions*** Well flow from any regularly used well is less than 90% of full capacity. A storage facility is not filled for 72 consecutive hours. An elevated storage tank is out of service due to repainting or other required maintenance.	***Moderate Water Shortage Conditions*** Well flow from any regularly used well is less than 80% of full capacity. A storage facility is not filled for 96 consecutive hours.	***Severe Water Shortage Conditions*** Well flow from any regularly used well is less than 70% of full capacity. A storage facility is not filled for 120 consecutive hours.	***Critical Water Shortage Conditions*** Well flow from any regularly used well is less than 60% of full capacity. A storage facility is not filled for 144 consecutive hours.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).
Nueces WSC (Nueces County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/NuecesWSC.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage falls below 40% of combined level.	***Severe Water Shortage Conditions*** When the LCC/CCR system storage falls below 30% of combined level.	***Critical Water Shortage Conditions*** When the LCC/CCR system storage falls below 20% of combined level.	***Emergency Water Shortage Conditions*** When the City Council or their designee determines that a water supply emergency exists. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Water production or distribution system limitation. Natural or man-made contamination of the water supply source(s).	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
River Acres WSC (Nueces County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/RiverAcres.pdf	***SW***	***Water Shortage Possibility*** Combined water stored in the Reservoirs is estimated to be 40% of total storage Capacity (LCC/CC)	***Water Shortage Warning*** Combined water supply in the reservoirs is less than 40% but greater than 30% of total storage capacity And the System Manager directs implementation in Order to protect reservoir levels (LCC/CC..	***Water Shortage Conditions*** Combine water stored in the reservoir system is equal To or less than 30% of total storage capacity and the System Manager directs implementation in order to Protect reservoir storage levels. (LCC/CC.	***Water Shortage Emergency*** Water supply in CCR/LCC reservoir system is estimated to be less than 65,000 acre-feet.	
City of Odem (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Odem.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage falls below 50% of maximum capacity. OR Lake Texana storage declines below 40% Water demand reaches 85% of firm production capacity OR ***A water system issue reduces capacity below 85% during high demand periods.***	***Moderate Water Shortage Conditions*** When the LCC/CCR system storage falls below 40% of maximum capacity. Water demand reaches 90% of firm production capacity OR ***A water system issue reduces capacity below 75% during high demand periods.***	***Severe Water Shortage Conditions*** When the LCC/CCR system storage falls below 30% of maximum capacity. Water demand reaches 95% of firm production capacity OR ***A water system issue reduces capacity below 70% during high demand periods.***	***Critical Water Shortage Conditions*** When the LCC/CCR system storage falls below 20% of maximum capacity. Water demand reaches 100% of firm production capacity.	***Emergency Water Shortage Conditions*** Extended period of the Severe or Critical condition. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to pro-vide water service. Natural or man-made contamination of the water supply source(s).

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Ingleside (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Ingleside.pdf	***SW***	***Mild Water Shortage Conditions*** Combined storage level of Choke Canyon Reservoir and Lake Corpus Christi declines below 50% or Lake Texana storage level declines below 40%. OR Water demand reaches eighty-five percent (85%) of firm production capacity OR A disruption due to equipment or distribution system failure that would limit the capacity of the water system below eighty-five percent (85%) of capacity during high demand periods	***Moderate Shortage Conditions*** Combined Lake and Reservoir levels declines to below 40%, OR Water demand exceeds ninety percent (90%) of the firm production Capacity OR A disruption due to equipment or distribution system failure that would limit the capacity of the water system below seventy five percent (75%) of capacity during high demand periods	***Severe Water Shortage Conditions*** Combined Lake and Reservoir levels declines to below 30%, OR Water demand reaches ninety-five percent (95%) of firm production capacity OR A disruption due to equipment or distribution system failure that would limit the capacity of the water system below seventy percent (70%) of capacity during high demand periods.	***Critical Water Shortage Conditions*** Combined Lake and Reservoir levels declines to below 20%. OR Water demand reaches one hundred percent (100%) of firm production capacity	***Emergency Water Shortage Conditions*** Extended period of the severe or critical condition, OR Any natural catastrophic situations that interrupt or have the potential to interrupt the City's potable water supply, including but not limited to the following: a) A major water line break, or pump or system failure occurs, which causes unprecedented loss of capability to provide water service: or b) Water distribution system limitations; OR c) Natural or man-made contamination of the water supply source occurs.
City of Taft (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Taft.pdf	***SW***	***Mild Water Shortage Conditions*** When the City of Corpus Christi and/or the San Patricio Municipal Water District declares this water shortage condition.	***Moderate Water Shortage Conditions*** When the City of Corpus Christi and/or the San Patricio Municipal Water District declares this water shortage condition.	***Severe Water Shortage Conditions*** When the City of Corpus Christi and/or the San Patricio Municipal Water District declares this water shortage condition.	***Emergency Water Shortage Conditions*** When the City of Corpus Christi and/or the San Patricio Municipal Water District declares this water shortage condition.	***Water Allocation*** When the City of Corpus Christi and/or the San Patricio Municipal Water District declares this water shortage condition. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Portland (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Portland.pdf	***SW***	***Mild Water Shortage Conditions*** When the LCC/CCR system storage is below 50% of maximum capacity. When Lake Texana storage is below 40% of maximum capacity.	***Moderate Water Shortage Conditions*** When the LCC/CCR system storage is estimated to be less than 40% of maximum capacity but greater than 30%.	***Severe Water Shortage Conditions*** When the LCC/CCR system storage is estimated to be less than or equal to 30% of maximum capacity.	***Critical Water Shortage Conditions*** When the LCC/CCR system storage is estimated to be less than or equal to 20% of maximum capacity.	***Emergency Water Shortage Conditions*** When the City of Corpus Christi determines that a water supply emergency exists based on: Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Water production or distribution system limitations. Natural or man-made contamination of water supply source(s).
Rincon WSC (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Rincon.pdf	***SW***	***Water Watch*** Any short-term or long-term situation requiring a 10% reduction in water consumption.	***Water Alert*** Any short-term or long-term situation requiring an 11% to 20% reduction in water consumption.	***Water Warning*** Any short-term or long-term situation requiring a 21% to 35% reduction in water consumption.	***Water Emergency*** Any short-term or long-term situation requiring a 36%or greater reduction in water consumption.	
County-Other Entities						
Aransas County MUD #1 (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/AransasMUD.pdf	***GW***	***Mild Drought Conditions (voluntary)*** When demand on the District's water supply reaches or exceeds 70% of the production capacity of such facilities for 5 consecutive days.	***Moderate Drought Conditions*** When demand on the District's water supply reaches or exceeds 90% of the production capacity of such facilities for 3 consecutive days.	***Severe Drought Conditions*** When demand on the District's water supply reaches or exceeds 100% of the production capacity of such facilities for 24 hours.		
Blueberry Hills (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/BlueberryHills.pdf	***GW***	***Customer Awareness*** Every April 1st, the utility will mail a public announcement to its customers.	***Voluntary Water Conservation*** Overnight Recovery fails to restore 90% of full storage capacity. Production or distribution limitations.	***Mandatory Water Use Restrictions*** Overnight Recovery fails to restore 85% of full storage capacity. Production or distribution limitations.	***Critical Water Use Restrictions*** Overnight Recovery fails to restore 80% of full storage capacity. Production or distribution limitations.	
Copano Heights Water Company (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Copano_2018.pdf	***SW***	***Customer Awareness*** Every April 1st, the utility will mail a public announcement to its customers.	***Voluntary Water Conservation*** Pump Flow less than 180 gpm or Total Daily Demand as 60% of pumping capacity	***Mandatory Water Use Restrictions*** Pump Flow less than 170 gpm or Total Daily Demand as 70% of pumping capacity	***Critical Water Use Restrictions*** Pump Flow less than 160 gpm or Total Daily Demand as 80% of pumping capacity	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Escondido Creek Estates (Hidalgo County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Escondido.pdf	***GW***	***Customer Awareness*** Every April 1st, the utility will mail a public announcement to its customers.	***Voluntary Water Conservation*** Wholesale Supplier, City of Rockport, Implements Drought Stage II (see Rockport)	***Mandatory Water Use Restrictions*** Wholesale Supplier, City of Rockport, Implements Drought Stage III (see Rockport)	***Critical Water Use Restrictions*** Wholesale Supplier, City of Rockport, Implements Drought Stage IV (see Rockport)	
McMullen County WCID #2 (McMullen County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/McMullen.pdf	***GW***	***Mild Water Shortage Conditions (voluntary)*** When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day.	***Moderate Water Shortage Conditions*** When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 90% overnight.	***Severe Water Shortage Conditions*** When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 80% overnight.	***Critical Water Shortage Conditions*** When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 75% overnight.	***Emergency Water Shortage Conditions*** Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Natural or man-made contamination of water supply source(s).
Baffin Bay WSC (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Baffin%20Bay%20WSC_DCP.pdf	***SW***	***Mild Conditions*** Consumption reaches 80% of Daily Max for 3 days OR Supply is 20% greater than average previous month consumption OR Extended period of low rain and daily use has risen 20% over same time last year.	***Moderate Conditions*** Consumption reaches 90% of Daily Max for 3 days. OR Water level in any storage tank cannot be replenished for 3 consecutive days.	***Severe Conditions*** Failure of major system component reducing minimum pressure in system below 20 psi for at least a day. OR Consumption of 95% or more of the maximum available for 3 days OR Natural of man-made disaster, or safety risk to public ORDeclaration of a state of disaster due to drought conditions in a county OR unforeseen events which could cause imminent health or safety risks to the public		

Table 7.8.
Region N DCP Responses for Each Trigger Level

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Water User Groups						
City of Aransas Pass (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/AransasPass.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in daily water demand.* All customers will be notified. Industrial customers, wholesale customers, and certain commercial customers will be required to develop and submit individual Water rationing plans to the City. All operations of the City of Aransas Pass shall adhere to water use restrictions.	***Moderate Water Shortage Conditions*** *Achieve a 15% reduction in daily water demand.* All City-owned facilities and operations will be placed on mandatory conservation practices. Restrictions on irrigation of landscaped areas, vehicle washing, use of water for pools, and ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a 25% reduction in daily water demand.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Certain industrial and commercial water users, which are not essential to the health and safety of the community, will be prohibited from water usage. Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a 35% reduction in daily water demand.* Additional restrictions on irrigation of landscaped areas and use of water for washing vehicles. The use of water for any type of pool is prohibited. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a 45% reduction in daily water demand.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Irrigation of landscaped areas and use of water to wash any vehicle is prohibited.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Rockport (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Rockport.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 5% reduction in daily water demand.* All customers are requested to limit landscape irrigation to once per week. Customers are requested to practice water conservation (minimize or discontinue use for non-essential purposes) All operations of the City of the city will adhere to water use restrictions.	***Moderate Water Shortage Conditions*** *Achieve a 10% reduction in daily water demand.* Use more repair crews for quicker response for water line leak repair. City crews monitor compliance with stage 2 restrictions on daily rounds. Restrictions on irrigation (Once per week) of landscaped areas, vehicle washing, use of water for pools, and ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a 15% reduction in daily water demand.* Eliminate Main Flushing unless needed for safety. Review customer water usage. Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Irrigation limited to once every other week. Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a 30% reduction in daily water demand* Landscaped watering prohibited at all times The use of water for any type of pool or vehicle is prohibited. Upon written notice cut off willful violators.	***Emergency Water Shortage Conditions*** *Achieve a 50% reduction in daily water demand.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Call 10 largest users and spread message of major outage. Business process discretionary practices are prohibited.
City of Three Rivers (Live Oak County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/3rivers.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a 5% reduction in water use.* Formal public notice of drought stage 1; notify TCEQ. Initiate increased public information campaign. Retail customers requested to follow stage 1 watering schedule. Increase leak detection activities.	***Moderate Water Shortage Conditions*** *Achieve a 10% reduction in water use.* Formal public notice of drought stage 2; notify TCEQ. Increase utility oversight of water use restrictions. Retail customers requested to follow stage 2 watering schedule. Increase utility oversight of water waste.	***Severe Water Shortage Conditions*** *Achieve a 15% reduction in water use.* Formal public notice of drought stage 3; notify TCEQ. Increase utility enforcement of water use restrictions. Retail customers requested to follow stage 3 watering schedule. Increase utility enforcement of water waste.	***Critical Water Shortage Conditions*** *Achieve a 30% reduction in water use.* Formal public notice of drought stage 4; notify TCEQ. Increase utility enforcement of water use restrictions. Retail customers requested to follow stage 3 watering schedule. No watering. Consider surcharges for excessive use.	***Emergency Water Shortage Conditions*** *Achieve necessary water use reduction.* Contact county and state emergency management coordinators; notify TCEQ. Implementation of appropriate emergency procedures. Consideration of water purchases by truckload or in bottles.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Beeville (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/beeville_cp.pdf	*SW*	***Mild Water Shortage Possibility*** Target limit of total treated water to less than 4.5 MGD. Water customers are requested to voluntarily reduce water use.	***Moderate Water Shortage Warning*** Target limit of total treated water to less than 3.5 MGD. Reduce water use for foundations, washing automobiles, prohibit building washings, restrict use of potable water to irrigate golf courses	***Severe Water Shortage Conditions*** Target limit of total treated water to less than 3 MGD. Reduce water use for foundations, washing automobiles, prohibit building washings, establish maximum monthly use for residential customers	***Critical Water Shortage*** Target limit of total treated water to less than 2.5 MGD. Reduce water use for foundations, washing automobiles, prohibit building washings, establish maximum monthly use for residential customers	***Emergency Water*** All non-essential water uses must cease in accordance with the Corpus Christi DCP. All customers will be notified.
Pettus MUD (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/PettusMUD.pdf	*GW*	***Mild Water Shortage Conditions*** All customers will be notified and asked to limit non-essential use. Raise Public Awareness	***Moderate Water Shortage Conditions*** Initiate mandatory restrictions on non-essential use (lawn watering etc.)	***Severe Water Shortage Conditions*** Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes. Initiate water surcharge	***Critical Water Shortage Conditions*** Initiate enforcement, fees, fines, and surcharges	***Emergency Conditions*** Initiate emergency response conditions
Falfurrias (Brooks County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Falfurrias_DCP_WCP_1999.pdf	*GW*	***Mild Water Shortage Conditions*** Achieve a voluntary 30% reduction in total water use or daily water demand. Water customers are requested to voluntarily limit the irrigation of landscaped areas to once per week and are requested to practice water conservation and to minimize or discontinue non-essential water use. No flushing of fire hydrants or hydrant testing at this time. City to adhere to Stage 2 water user restrictions.	***Moderate Water Shortage Conditions*** Achieve a 40% reduction in total water use or daily water demand. Restrictions on irrigation of landscaped areas, vehicle washing, use of water for hydrants pools, and ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of water for dust control; flushing gutters; failure to repair controllable leak(s); serving water to patrons at restaurants except when requested. No flushing of fire hydrants or flushing of dead end mains. Reduce irrigation of all public landscaped areas.	***Severe Water Shortage Conditions*** Achieve a 50% reduction in total water use or daily water demand Phase 2 restrictions and Prohibitions. Use of water for construction purposes to be discontinued. Prohibited: irrigation, watering of golf courses, pool use, vehicle washing construction and hydrant use under special permit	***Critical Water Shortage Conditions*** Achieve a 60% reduction in total water use or daily water demand All Phase 2 and 3 restrictions and Prohibitions. Prohibits: Irrigation of landscaped areas with hose end sprinkler or automatic sprinkler system, use of water to wash any vehicle, use of water for any type of pool. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** All Phase 2, 3, and 4 restrictions and Prohibitions. Irrigation of landscaped areas and use of water to wash motor vehicle, boat, trailers, or other vehicles is absolutely prohibited.

Water Systems	(SW/GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Freer WCID (Duval County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Freer.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 25% reduction in total water use.* All customers will be notified and asked to limit non-essential use Restricted use of water for ornamental fountains or ponds. All operations of Freer W.C.I.D. adhere to water use restrictions pre-scribed for Stage II of the plan.	***Moderate Water Shortage Conditions*** *Achieve a 30% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Critical Water Shortage Conditions*** *Achieve a 40% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Emergency Water Shortage Conditions*** *Achieve a 50% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	
San Diego MUD #1 (Duval County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/SanDiego.pdf	***GW***	***Mild Water Shortage Conditions*** Customers requested to voluntarily limit irrigation to twice a week at night. And to discontinue or mini-mize non-essential use. All operations of the City shall adhere to water use restrictions prescribed.	***Moderate Water Shortage Conditions*** *Achieve a reduction in daily water use.* Restrictions on irri-gation of landscaped areas, vehicle wash-ing, use of water for hydrants pools, and ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve an appro-priate reduction in daily water use.* Phase 2 restrictions and Prohibitions. Prohibited: irrigation, pool use, vehicle washing construction and hydrant use under special permit	***Mild Water Shortage Conditions*** Water use may be rationed	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Alice (Jim Wells County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Alice_DCP_2019.pdf	*SW*	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in total water use, daily water demand.* Weekly reports are provided to the news media. Wholesale water customers are contacted to discuss conditions and to request voluntary measures. Customers requested to voluntarily limit irrigation to twice a week. And to discontinue or minimize non- essential use. Flushing of water mains and watering of parks facilities is reduced. Alternative water sources are investigated. City operations shall adhere to Stage 2 water use restrictions.	***Moderate Water Shortage Conditions*** *Achieve a 15% reduction in total water use, daily water demand.* Wholesale water customers are contacted weekly requested to implement mandatory measures. Restrictions on irrigation of landscaped areas, vehicle washing, use of water for pools, and ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s). Serving water to patrons unless requested.	***Severe Water Shortage Conditions*** *Achieve a 20% reduction in daily water demand.* Wholesale water customers are contacted to discuss conditions and to request additional mandatory measures. Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes. Pro Rata curtailment of water diversions and/or deliveries for retail customers is initiated.	***Emergency Water Shortage Conditions*** *Reduce water use to less than 25% of the City's maximum daily supply capacity.* Utility directors of each wholesale water customer are contacted. Additional restrictions on irrigation of landscaped areas and water use for fountains or ponds. The use of water to wash any vehicle or for any type of pool is prohibited. Applications for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall require approval.	***Water Allocation*** *Achieve a 45% reduction in daily water demand.* Water is allocated according to the water allocation plan.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Orange Grove (Jim Wells County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/OrangeGrove.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in total water use.* All customers will be notified. Restricted use of water for ornamental fountains or ponds. All operations of the City shall adhere to water use restrictions prescribed for Stage II of the plan. Customers requested to practice conservation and minimize non-essential use	***Moderate Water Shortage Conditions*** *Achieve a 20% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s). Restaurants cannot provide water unless requested.	***Severe Water Shortage Conditions*** *Achieve a 30% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a 40% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool. Further Restrictions: Irrigation of landscaped areas, use of water to wash any vehicle, No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a 40% reduction in total water use.* Prohibits: Irrigation and vehicle washing.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Kingsville (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Kingsville.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in total water use.* All customers will be notified. Restricted use of water for ornamental fountains or ponds. All operations of the City shall adhere to water use restrictions prescribed for Stage II of the plan. Restricted flushing of water mains. Meetings are schedules with large industrial and commercial water users to exchange information regarding methods of saving water.	***Moderate Water Shortage Conditions*** *Achieve a 15% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a 25% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Emergency Water Shortage Conditions*** *Achieve a 35% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Water Allocation*** The City Manager is authorized to allocate water according to the water allocation plan.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Ricardo WSC (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Ricardo.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in daily water demand.* All customers will be notified. Restrictions on irrigation of landscaped areas.	***Severe Water Shortage Conditions*** *Achieve a 15% reduction in daily water demand.* Additional restrictions on irrigation of landscaped areas and limits use of water from hydrants.	***Critical Water Shortage Conditions*** *Achieve a 30% reduction in daily water demand.* May prohibit irrigation of landscaped areas. Additional restrictions on vehicle washing, use of water for pools, and use of water for building integrity. Water rate surcharges are implemented for retail and wholesale customers. Water rate surcharges may be implemented for residential customers. Upon written notice cut off willful violators. Applications for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind may not be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a voluntary 50% reduction in daily water demand.* Contact the largest ten water customers affected Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, and associated uses of water not related to business processes which are discretionary. Water rate surcharges may be implemented for residential customers.	
Riviera (Kleberg County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Riviera.pdf	***GW***	***Customer Awareness*** Water customers requested to limit non- essential use	***Voluntary Water Conservation*** Restricted days/hours for outside watering Restriction on wasting water (gutter flushing etc.)	***Mandatory Water Conservation*** Further restrictions on days/hours for outside watering, vehicle washing, pool filling, hydrant use. Prohibited: wash down of hard surfaces, dust con-trol, gutter flushing, other water wasting.	***Critical Water Conservation*** Prohibited: all outdoor water use, vehicle washing.	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
El Oso WSC (Service area includes 500 square miles located in Karnes, Bee, Wilson, and Live Oak Counties) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Eloso.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 20% reduction in total water use.* All customers will be notified. All operations of the corporation shall adhere to water use restrictions prescribed for Stage II of the plan.	***Moderate Water Shortage Conditions*** *Achieve a 30% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools, ornamental fountains, or ponds. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas other than for immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a 40% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a 50% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a 60% reduction in total water use.* Prohibits: Irrigation of landscaped areas and use of water to wash any vehicle.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
McCoy WSC (Service area includes 608 square miles located in Atascosa, Wilson, and Live Oak Counties) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/McCoy.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 20% reduction in total water use.* All customers will be notified. All operations of the corporation shall adhere to water use restrictions pre-scribed for Stage II of the plan.	***Moderate Water Shortage Conditions*** *Achieve a 30% reduction in total water use.* Restrictions on irri-gation of landscaped areas, vehicle washing, and use of water for pools, ornamental fountains, or ponds. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas other than for immediate fire protection; use of fire hydrants for purposes other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a 40% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a 50% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a 60% reduction in total water use.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Prohibits: Irrigation of landscaped areas and use of water to wash any vehicle.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Nueces WSC (Nueces County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/NuecesWSC.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in daily water demand.* All customers will be notified. Restrictions on irrigation of landscaped areas.	***Severe Water Shortage Conditions*** *Achieve a 15% reduction in daily water demand.* Additional restrictions on irrigation of landscaped areas and limits use of water from hydrants.	***Critical Water Shortage Conditions*** *Achieve a 30% reduction in daily water demand.* May prohibit irrigation of landscaped areas. Additional restrictions on vehicle washing, use of water for pools, and use of water for building integrity. Water rate surcharges are implemented for retail and wholesale customers. Water rate surcharges may be implemented for residential customers. Upon written notice cut off willful violators. Applications for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind may not be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a voluntary 50% reduction in daily water demand.* Contact the largest ten water customers affected Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, and associated uses of water not related to business processes which are discretionary. Water rate surcharges may be implemented for residential customers.	
River Acres WSC (Nueces County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/RiverAcres.pdf	***SW***	***Water Shortage Possibility*** Restrictions on irrigation of landscaped areas.	***Water Shortage Watch*** Additional restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools, ornamental fountains, or ponds, and wash down of buildings and structures. Prohibits: Wash down of hard-surfaced areas other than for immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Water Shortage Warning*** Additional restrictions on irrigation of landscaped areas and new service connections to the City's water system. Mandatory water use limits go into effect. All restaurants are prohibited from serving water to patrons except upon request of the patron. The use of water for any type of pool is prohibited.	***Water Shortage Emergency*** Water allocations to commercial and industrial customers are established. Maximum monthly water use and revised rate schedules established for resi-dential customers. No outside water use Any application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be must be approved.	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Odem (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Odem.pdf	***SW***	***Mild Water Shortage Conditions*** All customers will be notified. Water customers will be requested to voluntarily limit landscape irrigation to once a week. Commercial customers will be requested to voluntarily reduce use. Reduced watering of public parks and facilities.	***Moderate Water Shortage Conditions*** All customers will be notified. Additional restrictions on irrigation of landscaped areas, vehicle washing, use of water to maintain buildings, and use of water for pools, fountains, hydrants or ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters.	***Severe Water Shortage Conditions*** All customers will be notified. Additional restrictions on landscape irrigation and commercial nursery facilities. All restaurants are prohibited from serving water to patrons except upon request of the patron. Mandatory water use limits go into effect.	***Critical Water Shortage Conditions*** All customers will be notified. Prohibits irrigation of landscaped areas. Additional restrictions on the use of water for new agricultural land, to wash any vehicle, for building integrity, or for any type of pool. Drought surcharges are applied to deter discretionary water use.	***Emergency Water Shortage Conditions*** All customers will be notified. Prohibits irrigation of landscaped areas and use of water to wash any vehicle.
City of Ingleside (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Ingleside.pdf	***SW***	***Water Shortage Possibility*** All municipal operations are placed on mandatory conservation. Restrictions on irrigation of landscaped areas.	***Water Shortage Watch*** Additional restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools, ornamental fountains, or ponds, and wash down of buildings and structures. Prohibits: Wash down of hard-surfaced areas; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair defective plumbing and controllable leak(s).	***Water Shortage Warning*** Additional restrictions on irrigation and new service connections to the City's water system. Mandatory water use limits go into effect. All restaurants are prohibited from serving water to patrons except upon request of the patron. The use of water for any type of pool is prohibited.	***Water Shortage Emergency*** Water allocations to commercial and industrial customers are established. Maximum monthly water use and revised rate schedules established for residential customers. Any application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind must be approved.	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Taft (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Taft.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 5% reduction in total water use.* All customers will be notified. All operations of the City shall adhere to water use restrictions prescribed for Stage II of the plan.	***Moderate Water Shortage Conditions*** *Achieve a voluntary 10% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools, ornamental fountains, or ponds, and wash down of buildings and structures. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas other than for immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Severe Water Shortage Conditions*** *Achieve a voluntary 15% reduction in total water use.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes.	***Critical Water Shortage Conditions*** *Achieve a voluntary 30% reduction in total water use.* Additional restrictions on irrigation of landscaped areas and use of water for washing vehicles. The use of hose-end sprinklers and water for any type of pool is prohibited. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a voluntary 30% reduction in total water use.* Continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions. Prohibits: Irrigation of landscaped areas and use of water to wash any vehicle.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
City of Portland (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Portland.pdf	***SW***	***Mild Water Shortage Conditions*** *Achieve a 5% reduction in daily water demand.* Minimize or discontinue water system flushing and utilize reclaimed water for non-potable uses to the greatest extent possible. Water customers will be requested to voluntarily limit landscape irrigation to once a week. Water customers will be requested to limit or discontinue non-essential use.	***Moderate Water Shortage Conditions*** *Achieve a 10% reduction in daily water demand. More repair crews may be used for quicker response to water-line leaks.* Water customers are monitored for compliance. Additional restrictions on irrigation of landscaped areas, vehicle washing, use of water to maintain buildings, and use of water for pools, fountains, hydrants or ponds. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters.	***Severe Water Shortage Conditions*** *Achieve a 15% reduction in daily water demand.* Additional restrictions on irrigation of landscaped areas and the flushing of water mains. Water customers are monitored for compliance and violators are notified.	***Critical Water Shortage Conditions*** *Achieve a 30% reduction in daily water demand.* Water meters of willful violators are disconnected as necessary to prevent wasting of water. Prohibits irrigation of landscaped areas. Additional restrictions on the use of water to wash any vehicle or for any type of pool.	***Emergency Water Shortage Conditions*** *Achieve a 50% reduction in daily water demand.* Prohibits: Irrigation of landscaped areas and use of water to wash any vehicle. Business process water shall be reduced to a basic amount necessary.

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Rincon WSC (San Patricio County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Rincon.pdf	***SW***	***Water Watch*** *Achieve a 10% reduction in total water use.* All customers will be notified. Disseminate water conservation information to retail customers. Minimize water system flushing and system water-waste. Intensify efforts of the Leak Detection and Repair Program.	***Water Alert*** *Achieve a 11% to 20% reduction in total water use.* Additional restrictions on irrigation of land-scaped areas, and ornamental ponds. Establish mandatory water consumption restrictions. All water taken from flush valves, other than for flushing purposes shall be metered, and the Corporation shall charge for this water in accordance with the current rate schedule. Prohibits: Wash down of hard-surfaced areas; and water to run or accumulate in any gutter or street.	***Water Warning*** *Achieve a 21% to 35% reduction in total water use.* Additional landscape irrigation restrictions. Except when empty, all swimming pools shall be covered when not in use. Restricted use of water to wash any vehicle.	***Water Emergency*** *Achieve a 36% or greater reduction in total water use.* Prohibition of all non-essential water use, unless necessary for the preservation of health and safety and welfare. Water usage for livestock is exempt.	
County-Other Entities						
Aransas County MUD #1 (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/AransasMUD.pdf	***GW***	***Mild Drought Conditions (voluntary)*** *Target Reduction in Well Run Time = 5%* All customers will be notified. Restricted landscape irrigation.	***Moderate Drought Conditions*** *Target Reduction in Well Run Time = 10%* All outdoor water use must be conducted with a hand-held hose with a manual on-off nozzle. Restricted street washing, fire hydrant flushing, and filling of swimming pools.	***Severe Drought Conditions*** *Target Reduction in Well Run Time = 15%* All outdoor water use is prohibited. A surcharge equal to 200% of the appli-cable rate for all water used in excess of 10,000 gallons/ month shall be imposed on all customers.		
Blueberry Hills (Bee County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/BlueberryHills.pdf	***GW***	***Customer Awareness*** Water customers requested to limit non- essential use	***Voluntary Water Conservation*** *Achieve 25% reduction in total use* Restricted days/hours for outside watering Restriction on wasting water (gutter flushing etc.)	***Mandatory Water Conservation*** *Achieve 40% reduction in total use* Further restrictions on days/hours for outside watering, vehicle washing, pool filling, hydrant use. Prohibited: wash down of hard sur-faces, dust control, gutter flushing, other water wasting.	***Critical Water Conservation*** *Achieve 55% reduction in total use* Prohibited: all outdoor water use, vehicle washing.	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Copano Heights Water Company (Aransas County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Copano_2018.pdf	***SW***	***Customer Awareness*** Water customers requested to limit non- essential use and voluntary limit the irrigation of landscaped areas to once per week	***Voluntary Water Conservation*** *Achieve 10% reduction in total use* Restricted days/hours for outside watering Restriction on wasting water (gutter flushing etc.)	***Mandatory Water Conservation*** *Achieve 15% reduction in total use* Further restrictions on days/hours for outside watering, vehicle washing, pool filling, hydrant use. Prohibited: wash down of hard sur-faces, dust control, gutter flushing, other water wasting.	***Critical Water Conservation*** *Achieve 30% reduction in total use* Prohibited: all outdoor water use, vehicle washing.	
Escondido Creek Estates (Hidalgo County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Escondido.pdf	***GW***	***Customer Awareness*** Water customers requested to limit non- essential use	***Voluntary Water Conservation*** Restricted days/hours for outside watering Restriction on wasting water (gutter flushing etc.)	***Mandatory Water Conservation*** Further restrictions on days/hours for outside watering, vehicle washing, pool filling, hydrant use. Prohibited: wash down of hard sur-faces, dust control, gutter flushing, other water wasting.	***Critical Water Conservation*** Prohibited: all outdoor water use, vehicle washing.	
McMullen County WCID #2 (McMullen County) https://www.nueces-ra.org/CP/RWPG/dcp_pdf/McMullen.pdf	***GW***	***Mild Water Shortage Conditions*** *Achieve a voluntary 10% reduction in total water use.* All customers will be notified and asked to limit non-essential use Restricted use of water for ornamental fountains or ponds. All operations of Freer WCID adhere to water use restric-tions prescribed for Stage II of the plan.	***Moderate Water Shortage Conditions*** *Achieve a 25% reduction in total water use.* Restrictions on irrigation of landscaped areas, vehicle washing, and use of water for pools. All restaurants are prohibited from serving water to patrons except upon request of the patron. Prohibits: Wash down of hard-surfaced areas and structures for purposes other than immediate fire protection; use of fire hydrants for any purpose other than firefighting; use of water for dust control; flushing gutters; failure to repair controllable leak(s).	***Critical Water Shortage Conditions*** *Achieve a 50% reduction in total water use.* Additional restrictions on irrigation of landscaped areas, watering of golf course, and use of water for construction purposes. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved during this stage.	***Emergency Water Shortage Conditions*** *Achieve a 75% reduction in total water use.* Prohibits: Irrigation of landscaped areas, use of water to wash any vehicle, use of water for any type of pool.	

Water Systems	(SW/ GW)	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Baffin Bay WSC https://www.nueces-ra.org/CP/RWPG/dcp_pdf/Baffin%20Bay%20WSC_DCP.pdf	***SW***	***Mild Conditions*** Outside water use restrictions, reduced flushing operations, encouraged customer use reduction	***Moderate Conditions*** Prohibited outside water use, public service announce-ments	***Severe Conditions*** All outside watering prohibited. Use will be restricted to a percentage of previous months use. WSC shall continue enforcement and educational efforts.		

Note: Stages 2- 5 for all drought contingency plans include continuation of restrictions set forth in previous conditions and implementation of additional regulations and prohibitions.

7.2.4 Coastal Bend RWPG Drought Response Recommendations

On February 7, 2019, a subcommittee[7] comprised of Coastal Bend Regional Water Planning Group members was formed to develop drought response recommendations and compile information about emergency water interconnections in the region. The subcommittee met on April 23, 2019 and prepared the following recommendations which were adopted by the Coastal Bend Regional Water Planning Group on May 9, 2019:

- The Coastal Bend Regional Water Planning Group considered TAC Chapter 357.42(c) provisions to identify factors specific to each source of water supply to be considered in determining whether to initiate a drought response, actions to be taken as part of the drought response, and triggers and actions in response to drought. The Coastal Bend Regional Water Planning Group supports the drought response triggers and actions identified in local WUG DCPs for existing sources (see Tables 7.1 to 7.8).

- In response to a new TWDB provision to include whether measures have been recently implemented in response to drought conditions, the Coastal Bend Regional Water Planning Group recognizes that the City of Corpus Christi's direct and indirect customers are required to adhere to the City of Corpus Christi DCP criteria and reductions. At this time, it is impractical to poll all 40+ municipal WUGs to inquire about the implementation status of DCP measures and TWDB funding has not been provided for this activity.

- The Coastal Bend Regional Water Planning Group considered the new provision from the TWDB for RWPGs to identify unnecessary or counterproductive variations in specific drought response strategies that may confuse the public or otherwise impede drought response efforts. The Coastal Bend Regional Water Planning Group assumes WUGs during development of their DCPs have identified meaningful triggers, water reduction goals, and best management practices to achieve those goals and are tracking their progress and revising when appropriate in DCP updates.

[7] Coastal Bend Drought Response Subcommittee participants included: Ms. Teresa Carrillo, Ms. Carola Serrato, Mr. Mark Scott, and Mr. Scott Bledsoe.

- The Coastal Bend Regional Water Planning Group does not recommend alternative drought management water management strategies for WUGs and/or WWPs beyond those identified in the local DCPs. The CBRWPG recognizes that local entities invest time and resources in preparing their DCPs and, for this reason, does not recommend preparing additional recommendations that might deviate, conflict, or alter drought measures identified in local WUG and WWP DCPs.

- The Coastal Bend Regional Water Planning Group considered not meeting needs as a potentially feasible drought management water management strategy and requested at the February 7, 2019 meeting that the TWDB conduct a socioeconomic impact need analysis of the cost of not meeting needs. Although this drought management strategy was considered, it was not recommended by the Coastal Bend Regional Water Planning Group, as discussed in more detail in Chapter 7.6.

- The Coastal Bend Regional Water Planning Group recommends that the triggers and drought stages for severe and critical/emergency conditions identified in local DCPs be implemented and enforced accordingly to protect human health and water supply. See Tables 7.7 and 7.8 for details.

7.3 Existing and Potential Interconnects

A goal of the regional planning process is to provide for sufficient supplies that meet or exceed DOR demands for the next 50 years. However, it is also important for regions to plan for emergency supplies in the event of a prolonged drought or an interruption/impairment of supply from an existing source. An interconnection between two collaborating municipal water user groups (WUGs) can serve as an alternative means of providing drinking water in case of these events in lieu of trucking in supply or other expensive options. In compliance with Texas Administrative Code (TAC) Chapter 357 Regional Water Planning Guidelines, available information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water was collected by the Coastal Bend Regional Water Planning Group.

On April 23, 2019, a subcommittee comprised of CBRWPG members met to discuss emergency interconnections identified in the 2016 Coastal Bend Regional Water Plan and updates for emergency interconnections for new WUGs in the area. TCEQ representatives were in attendance at the meeting and reported that no new WUGs have emergency connections. Existing and potential interconnects that were identified for municipal WUGs with populations less than 7,500, utilities with a single source of water supply, or county-other WUGs in accordance with TAC 357.42(d)-(g) provisions are presented in Chapter 7.4, Table 7.9. The subcommittee also evaluated potential emergency responses to local drought conditions or loss of existing water supplies and likely alternative water sources and major water infrastructure facilities in the event that the existing supplies become temporarily unavailable due to unforeseeable conditions. Local DCPs were reviewed for information related to emergency connections or facilities that are disallowed for emergency connection. For the purposes of emergency response analysis, it was assumed that entities evaluated would have 180 days or less of remaining supply.

7.4 Emergency Response to Local Drought Conditions or Loss of Municipal Supply

The regional and state water plans aim to prepare entities for worst case drought scenarios based on the DOR as described in Chapter 7.1. While rare, it is important to have a back-up plan in case of infrastructure failure or water supply contamination. This is especially important for smaller entities which rely on a sole source of supply or a sole WWP. While many WUGs and WWPs have DCP's as described in Chapter 7.2, it is less common for small municipalities or county-other WUGs to have these emergency plans.

The Region N drought response and emergency connections subcommittee identified 43 potential interconnects as reported in Table 7.9 for small WUGs with populations less than 7,500, those relying on a sole-source of water, and all County-Other WUGs in the Region. These potential emergency interconnects were assigned under the general principle that entities relying on surface water supplies would consider groundwater; and entities relying on groundwater would consider surface water supplies from the nearest neighboring water system.

A broad range of emergency situations could result in a loss of a reliable municipal supply and it is not possible to plan one solution to meet any possible emergency, for that reason a range of possible responses were selected for each entity in Table 7.9 based on source type and location. A WUG utilizing groundwater was analyzed for potential additional fresh water and brackish water wells based on the existence of appropriate aquifers in the area. MAG availability was not considered since the wells are assumed temporary over the course of an emergency. Surface water WUGs were analyzed for curtailment of junior water rights, no releases from upstream reservoirs were considered since most surface water users in the region rely on Corpus Christi reservoirs.

Table 7.9.
Potential Emergency Supply Options for Small WUGs

Entity				Local Groundwater Well	Brackish Groundwater Well	Truck in Water	Supply from Nearby Entity	Implementation Requirements		
Water User Group	**County**	**2020 Population**	**2020 Demand (ac-ft)**					**Known Existing Interconnect**	**Potential Entity Providing Supply**	**Type of Infrastructure Required**
Aransas County-Other	Aransas	4,416	491	X		X				Well, Pipeline, Transportation
Aransas Pass	Aransas, Nueces,	10,541	1,504	X		X				Well, Pipeline, Transportation

Entity								Implementation Requirements		
Water User Group	County	2020 Population	2020 Demand (ac-ft)	Local Groundwater Well	Brackish Groundwater Well	Truck in Water	Supply from Nearby Entity	Known Existing Interconnect	Potential Entity Providing Supply	Type of Infrastructure Required
	San Patricio									
Baffin Bay WSC	Kleberg	1,440	237			X	X			Pipeline, Transportation
Bee County-Other	Bee	13,472	1,875	X		X				Well, Pipeline, Transportation
Bishop	Nueces	3,446	593	X	X	X	X	STWA		Well, Pipeline, Transportation
Brooks County-Other	Brooks	1,765	224			X				
Corpus Christi Naval Air Station	Nueces	707	1,085	X	X	X				Well, Pipeline, Transportation
Driscoll	Nueces	812	105	X	X	X				Well, Pipeline, Transportation
Duval County CRD	Duval	1,859	260			X	X			Pipeline, Transportation
Duval County-Other	Duval	3,771	477			X	X		Alice	Pipeline, Transportation
El Oso WSC	Live Oak	1,290	278			X	X		Karnes City	Pipeline, Transportation
Falfurrias	Brooks	6,018	1,639			X	X		Alice or Premont	Pipeline, Transportation
Freer	Duval	3,041	687			X	X			Pipeline, Transportation
George West	Live Oak	2,374	435			X	X		Three Rivers	Pipeline, Transportation
Gregory	San Patricio	2,024	339	X		X				Well, Pipeline, Transportation
Jim Wells County FWSD 1	Jim Wells	1,943	131			X	X			Pipeline, Transportation
Jim Wells County-Other	Jim Wells	14,775	2,095	X		X				Well, Pipeline, Transportation
Kenedy County-Other	Kenedy	463	244			X				Transportation
Kleberg County-Other	Kleberg	1,527	257			X	X	Ricardo WSC		Pipeline, Transportation
Live Oak County-Other	Live Oak	5,166	637	X		X				Well, Pipeline, Transportation
Mathis	San Patricio	5,144	653			X	X		Interconnection to MRP supplies through Corpus Christi	Pipeline, Transportation

Entity								Implementation Requirements		
Water User Group	County	2020 Population	2020 Demand (ac-ft)	Local Groundwater Well	Brackish Groundwater Well	Truck in Water	Supply from Nearby Entity	Known Existing Interconnect	Potential Entity Providing Supply	Type of Infrastructure Required
McCoy WSC	Live Oak	170	21			X	X		Three Rivers	Pipeline, Transportation
McMullen County-Other	McMullen	734	97			X				
Naval Air Station Kingsville	Kleberg	53	256			X	X		Ricardo WSC	Pipeline, Transportation
Nueces County WCID 3	Nueces	12,467	2,957			X	X		STWA	Pipeline, Transportation
Nueces County WCID 4	Nueces	4,846	2,465		X	X	X	SPMWD, Corpus Christi		Pipeline, Transportation
Nueces County-Other	Nueces	11,222	1,475	X	X	X				Well, Pipeline, Transportation
Nueces WSC	Nueces	2,713	457		X	X	X	Nueces County WCID # 3	Nueces County WCID #3	Pipeline, Transportation
Odem	San Patricio	2,647	395	X	X	X	X		GW	Well, Pipeline, Transportation
Orange Grove	Jim Wells	1,838	476			X	X		Alice	Pipeline, Transportation
Pettus MUD	Bee	700	104			X	X			Pipeline, Transportation
Premont	Jim Wells	2,923	709			X	X		Alice	Pipeline, Transportation
Ricardo WSC	Kleberg	2,919	340		X	X	X	City of Kingsville	City of Kingsville	Pipeline, Transportation
Rincon WSC	San Patricio	3,660	368	X	X	X	X		Sinton	Well, Pipeline, Transportation
River Acres WSC	Nueces	2,662	426			X	X		Corpus Christi	Pipeline, Transportation
Riviera Water System	Kleberg	736	114			X	X			Pipeline, Transportation
San Diego MUD 1	Duval and Jim Wells	4,986	921			X	X		Alice	Pipeline, Transportation
San Patricio County-Other	San Patricio	5,950	843	X		X				Well, Pipeline, Transportation
Sinton	San Patricio	5,738	1,345			X	X		SPMWD	Pipeline, Transportation
Taft	San Patricio	3,768	540			X	X		Sinton	Pipeline, Transportation
TDCJ Chase Field	Bee	3,425	1,024			X	X		Beeville	Pipeline, Transportation
Three Rivers	Live Oak	3,146	545	X		X				Well, Pipeline, Transportation

Entity								Implementation Requirements		
Water User Group	**County**	**2020 Population**	**2020 Demand (ac-ft)**	**Local Groundwater Well**	**Brackish Groundwater Well**	**Truck in Water**	**Supply from Nearby Entity**	**Known Existing Interconnect**	**Potential Entity Providing Supply**	**Type of Infrastructure Required**
Violet WSC	Nueces	2,142	186			X	X		NUECES COUNTY WCID 3	Pipeline, Transportation

A nearby entity that could provide supply in the case of an isolated incident was identified for each WUG if existing or potential interconnects were known. In addition, trucking in water was considered as a supply option under severe circumstances. Any infrastructure required for implementation of the options was noted as well. Information on existing and potential interconnect supply capacity or location was generally not available from either source.

The TCEQ provides support to help public water systems plan in advance of an emergency or service interruption at the following website: https://www.tceq.texas.gov/drinkingwater/homeland_security/disasterprep/disasterprep.html

At the request of the CBRWPG, a list of resources and local Emergency Management Offices in the Coastal Bend Region that can help provide aide and assistance in case of emergency include:

American Red Cross- Coastal Bend (361) 887-9991
Nueces County Emergency Management (361) 888-0513
Texas Division of Emergency Management- Region 3 (956) 565-7120
TCEQ- Region N (361) 825- 3100
Corpus Christi Emergency Management (361) 826-1100

7.5 Region Specific Drought Response Recommendations and Model Drought Contingency Plans

7.5.1 Region Specific Drought Response Recommendations

The CBRWPG acknowledges that DCPs are a useful drought management tool for entities with both surface and groundwater sources and recommends that all entitles consider adopting a DCP in preparation for drought conditions. The region also recommends that in accordance with TCEQ guidelines, entities update their DCPs every 5 years as triggers can change as wholesale and retail water providers reassess their contracts and supplies. The Nueces River Authority obtained 31 drought contingency plans from across the region. Fifteen of these participating water providers and WUGs rely solely on surface water, 11 entities rely solely on groundwater and 5 of them utilize both sources to meet needs.

An analysis was performed based on the known DCPs to determine the most common drought contingency measures used in Region N. A summary of the results is shown in Table 7.10 and the detailed information is found in Table 7.11. Region N suggests that entities without a DCP could determine which drought contingency measures to adopt by considering the DCPs of other regional WUGS with similar populations and supply types.

7.5.2 Model Drought Contingency Plans

TCEQ provides model drought contingency plans[8] for wholesale and retail water suppliers to provide guidance and suggestions to entities with regard to the preparation of drought contingency plans. Not all items in the model will apply to every systems situation, but the overall model can be used as a starting point for most entities.

The CBRWPG recommends that a list of the common drought contingency measures for the Coastal Bend Region (Table 7.11) be considered for municipal and WWPs, in addition to TCEQ Model DCPs for Region N entities wishing to develop a new DCP. Region-specific model drought contingency plans are included in Appendix D.

Table 7.10.
Region N Drought Contingency Summary

Common Drought Contingency Measure	Number of Region N DCPs Recommending
Watering schedules/ Landscape irrigation restrictions	31
Water demand reduction targets	28
Potable water use restrictions	10
Vehicle washing restrictions	28
Restrictions on wash down of hard-surfaces, buildings, and/or structures	26
Restrictions on new service connections, pipeline extensions, etc.	16
Restrictions on serving water to patrons at restaurants	15
Restrictions on flushing gutters, controllable leaks, and/or permitting water to run or accumulate	27
Restrictions on the use of water for pools, ponds, or fountains	28
Restrictions on use of water for dust control	22
Others	27

[8] https://www.tceq.texas.gov/assets/public/permitting/watersupply/drought/dcpiou.pdf

Table 7.11. Common Drought Response Measures

Wholesale Water Provider/Water User Group	Census 2010 (For Water User Groups Only)	DCP Available	Date	Drought Contingency Measures: Watering schedules/ Landscape irrigation restrictions	Water demand reduction targets	Potable water use restrictions	Vehicle washing restrictions	Restrictions on wash down of hard-surfaces, buildings, and/or structures	Restrictions on new service connections, pipeline extensions, etc.	Restrictions on serving water to patrons at restaurants	Restrictions on flushing gutters, controllable leaks, and/or permitting water to run or accumulate	Restrictions on the use of water for pools, ponds, or fountains	Restrictions on use of water for dust control	Others	Water Supplies: SW	GW
Wholesale Water Providers																
City of Corpus Christi		Y	2018	√	√	√	√	√	√			√		√	√	
SPMWD		Y	2019	√	√	√	√	√				√	√	√	√	
South Texas Water Authority		Y	2018	√	√									√	√	
Nueces County WCID #3		Y	2019	√	√	√	√	√				√			√	
LNRA		Y	2014		√									√	√	
Water User Groups																
Aransas Pass	8,204	Y	2008	√	√		√	√	√	√	√	√	√	√	√	√
Rockport	8,766	Y	2013	√	√		√	√			√	√	√	√	√	
Baffin Bay WSC	N/A	Y	2015	√	√		√	√			√	√				√
Beeville	12,863	Y	2020	√	√	√	√	√	√			√	√	√	√	
City of Three Rivers	1,848	Y	2014	√	√		√	√			√	√	√		√	√
San Diego MUD #1	4,488	Y	2000	√	√		√	√			√	√	√	√		√
Alice	19,104	Y	2019	√	√		√	√	√	√	√	√	√	√	√	
Orange Grove	1,318	Y	2000	√	√		√	√	√	√	√	√	√	√		√
Kingsville	26,213	Y	2002	√	√		√	√	√	√	√	√	√	√	√	√
Ricardo WSC	2,631	Y	2018	√	√	√	√	√	√	√	√	√	√	√	√	
El Oso WSC	1,019	Y	2009	√	√		√	√	√	√	√	√	√	√		√
McCoy WSC	169	Y	2000	√	√		√	√	√	√	√	√	√	√		√
Nueces WSC	2,322	Y	2019	√	√	√	√	√	√	√	√	√	√	√	√	
River Acres WSC	2,421	Y	2000	√	√	√	√	√	√	√	√	√	√	√	√	
Odem	2,389	Y	2013	√	√	√	√	√	√	√	√	√		√	√	
Ingleside	9,387	Y	2018	√	√	√	√	√	√	√	√	√	√	√	√	√
Taft	3,048	Y	2013	√	√		√	√	√	√	√	√	√	√	√	
Portland	15,099	Y	2013	√	√	√	√	√	√	√	√	√	√	√	√	
Rincon WSC	3,243	Y	2009	√	√		√				√	√		√	√	
County-Other Entities																
Aransas County MUD #1		Y	2009	√							√			√		√
Blueberry Hills		Y	2005	√	√		√	√			√	√	√	√		√
Copano Heights Water Company		Y	2018	√	√		√	√			√	√	√		√	
Escondido Creek Estates		Y	2000	√			√			√	√	√	√	√		√
Freer WCID		Y	2000	√	√		√	√	√	√	√	√	√	√		√
Riviera		Y	2000	√			√	√			√	√	√	√		√
Baffin Bay WSC			2015	√	√											√
Pettus MUD		Y	2000	√			√	√			√	√		√		√

7.6 Drought Management WMS

The Coastal Bend Regional Water Planning Group adopted safe yield measures when considering water supplies for nearly 80% of the regional water demands. The regional water plan is developed to meet projected water demands with a safe yield reserve of 75,000 ac-ft in CCR/LCC storage during worst historical drought conditions as a provision for future drought uncertainty. The Coastal Bend Regional Water Planning Group sees the purpose of the planning as ensuring that sufficient supplies are available to meet future water demands. Additional drought management recommendations have not been made by the CBRWPG as a water management strategy for specific WUG needs. Reducing water demands during a drought as a defined water management strategy does not ensure that sufficient supplies will be available to meet the projected water demands; but simply eliminates the demands.

While the CBRWPG encourages entities in the region to promote demand management during a drought, it should not be identified as a "new source" of supply. Recommending demand reductions as a water management strategy is antithetical to the concept of planning to meet projected water demands. It does not make more efficient use of existing supplies as does conservation, but instead effectively turns the tap off when the water is needed most. It is planning to not meet future water demands. At CBRWPG request, the TWDB conducted a Socioeconomic Analysis of Not Meeting Needs for the 2021 Region N Plan, included in Appendix B.

While Drought Management WMSs are not identified by Region N, DCPs are encouraged for all entities and the region supports the implementation of the drought responses outlined in these DCPs when corresponding triggers occur. While the relief provided from these DCP responses can prolong supply and reduce impacts to communities, they are not seen as reliable for all entities under all potential droughts.

7.7 Other Drought Recommendations

7.7.1 Model Updates

It is of utmost importance that regional water planning groups have the most up-to-date information available to make decisions. The Corpus Christi Water Supply Model is used to determine both the DOR and the safe yield of reservoirs, and was updated through 2015. The CBRWPG recommends that the Texas legislature continue to support TCEQ and regional water planning groups to pursue updated WAMs and Water Supply Models. This will be especially important if the duration of the recent drought continues or the severity increases.

7.7.2 Monitoring and Assessment

Region N recommends that all entities monitor the drought situation around the state and locally in order to prepare and facilitate decisions. Several state and local agencies are monitoring and reporting on conditions with up to date information. A few informative sources are listed below.

- Nueces River Authority Pass-Through Data: https://www.nuecesra.org/CP/CITY/passthru/index.php.

- TWDB Drought Information: http://waterdatafortexas.org/drought/.
- TCEQ Drought Information: https://www.tceq.texas.gov/response/drought.

In addition, the CBRWPG supports the efforts of the Texas Drought Preparedness Council (DPC) and recommends that entities review information developed by the council. The DPC was established by the legislature in 1999 and is composed of 15 representatives from several state agencies. The council is responsible for assessment and public reporting of drought monitoring and water supply conditions, advising the governor on drought conditions, and ensuring effective coordination among agencies. The DPC is currently promoting outreach to inform entities of the assistance they can provide and looking for input as to how they can be more useful. The CBRWPG suggests that WUGs consider the resources available to them through the DPC such as the Drought Annex which describes the activities that help minimize potential impacts of drought and outlines an effective mechanism for proactive monitoring and assessment and was published in 2014. More information on the DCP can be found here: http://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/stateDroughtPrepCouncil.htm.

The CBRWPG received a letter from the DPC dated August 1, 2019 that included recommendations to (a) fully address assessment of current drought preparations according to Chapter 7 template and (b) develop region-specific model DCPs for all water use categories in the region that account for more than 10% water demands in any decade over the 50-year planning horizon. Specifically, the DPC recommendation translates to request that Region N consider developing *region-specific* model drought contingency plans for: Irrigation, Manufacturing, and Municipal sectors. The CBRWPG considered the recommendations of the DPC; however, it was determined that it was not practical to develop region specific DCPs for manufacturing and irrigation sectors. The CBRWPG requests that representatives from the DPC present information early in the planning process regarding their recommendations and that the TWDB provide financial support to Regional Water Planning Groups to address DPC recommendations. Furthermore, the CBRWPG encourages the DPC to attend a regional water planning group meeting during future planning cycles.

The State Drought Preparedness Plan, issued by the DPC in February 2006, emphasizes the importance of pro-active drought monitoring and provides agency resources that collect drought-related data and provide assistance. The State Drought Preparedness Plan presents resources that are available for mitigation and preparedness, response, and recovery. It continues by identifying climatological, agriculture, and water availability indices for each of ten climatic regions in Texas to consider when assessing drought severity. The Coastal Bend Region (Region N) counties are located in two climatic regions (Region 7 and 8) and, as discussed in the report, “climatic regions are so large, that drought indices developed across regions of this magnitude routinely mask smaller, regional drought problems and emerging drought conditions”. For this reason, the CBRWPG considered the State Drought Preparedness Plan and information from the DPC but selected information provided by local, approved drought contingency plans for development of drought response recommendations.

8

Legislative Recommendations, Unique Stream Segments, and Reservoir Sites

[31 TAC §357.43]

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Chapter 8: Legislative Recommendations, Unique Stream Segments, and Reservoir Sites

Each of the 16 regional water planning groups may make recommendations to the TWDB regarding legislative and regional policy recommendations; identification of unique ecological stream segments; and identification of sites uniquely suited for reservoirs. The Coastal Bend RWPG formed a subcommittee at an open meeting on February 7, 2019 to consider legislative and regional policy recommendations. The subcommittee met on April 23, 2019 to discuss and prepare such recommendations, which were adopted by the Coastal Bend Region on May 9, 2019. The following are the Coastal Bend Region's recommendations regarding these matters.

8.1 Legislative and Regional Policy Recommendations

Under the authority of Senate Bill 1, the Coastal Bend RWPG has developed the following legislative and regional policy recommendations.

8.1.1 General Policy Statement

I. The Texas Legislature is urged to declare that: i) all water resources of the State are hydrologically inter-related and should be managed on a "conjunctive use" basis, wherever possible; ii) existing water supplies should be more efficiently and effectively used through improved conservation and system operating policies; and iii) water re-use should be promoted, wherever practical, taking into account appropriate provisions for protection of downstream water rights, domestic and livestock uses, and environmental flows.

II. The Coastal Bend Region urges the legislature to support policies and programs to meet Texas' water supply needs and prepare for and respond to drought conditions.

III. The Texas Legislature should continue to provide funding to the TWDB and other state agencies for water conservation initiatives, including providing technical support and assistance to water user groups regarding public information programs; leak detection, repair, and monitoring; meter testing and replacement; or other best management practices included in their water conservation programs.

IV. The Texas Legislature is urged to make funds available through regional water planning groups and groundwater conservation districts to educate the citizens of Texas about all water issues, as well as the powers and benefits of groundwater conservation districts and river authorities.

8.1.2 Interbasin Transfers

I. The Texas Legislature is urged to repeal the "Junior Rights" provision and the additional application requirements for interbasin transfers that were included in Senate Bill 1.

8.1.3 Desalination

I. The Texas Legislature is urged to direct TCEQ to investigate the current regulatory status of the "concentrate", "reject water", or "byproduct discharge" produced during the desalination of brackish ground water, brackish surface water and seawater in industrial and municipal treatment processes and compare these to reject water requirements for the oil and gas industry and arrive at a common set of standards for the disposal of these waste products so that safe, economical methods of disposal will be available to encourage the application of these technologies in Texas. TCEQ is encouraged to consider and promulgate regulations to define standards related to quality and quantity of byproduct discharge and location.

II. The Texas Legislature is urged to direct TCEQ to work with TWDB, TPWD and encouraged to work with USFWS (United States Fish and Wildlife Service), USACE (United States Army Corps of Engineers), and National Marine Fisheries Services to develop information on the potential environmental impacts of concentrate discharges from seawater desalination facilities and to facilitate the permitting of these discharges into tidal waters where site specific information shows that minimal environment damage would occur. Stewardship plans, to preserve economic diversification through environmental protection, should be included among the Legislature's support options. Off-shore zones in the Gulf of Mexico identified in the 2018 "Marine Seawater Desalination Diversion and Discharge Zones Study" by the Texas Parks and Wildlife Department and the General Land Office in response to House Bill 2031 and at the request of the 84th State Legislature should be considered for seawater desalination projects.

III. Texas Legislature is urged to amend state laws governing the procurement of professional services by public agencies in order to allow municipalities, water districts, river authorities, smaller communities, and other public entities, provided that they have the expertise, to utilize alternative delivery methods for public work projects, including desalination facilities. For example, some large-scale desalination facilities are now constructed using CMAR (Construction-Management-at-Risk) or Public Private Partnership methods, allowing for a cost-effective transfer of project risks to the private sector.

IV. The Texas Legislature is urged to support evaluation, construction and implementation of a pilot desalination plant to quantify and qualify impacts of operating a brackish or seawater desalination facility in the Coastal Bend Region. Avoidance of environmentally sensitive bay and estuary ecological systems should be considered during planning and evaluation of brine disposal options, which may include considering deep well injection and brackish groundwater options that produce less brine.

V. An evaluation should be undertaken of the feasibility of a regional desalination facility for the treatment of poor quality groundwater or seawater to improve the quality of potable water for the cities of San Diego, Freer, Benavides, Premont, and Falfurrias.

VI. Studies of desalination options to further reduce the cost of using seawater and/or brackish groundwater should be continued.

8.1.4 Groundwater Management

I. The Texas Legislature is urged to provide funding for the Groundwater Management Areas to support their efforts towards the evaluation of groundwater availability and desired future conditions.

II. Studies of the potential to develop ASR system(s) in the Gulf Coast Aquifer should be continued to help drought-proof water supplies in the Region.

III. The TWDB, TCEQ, and the Texas Railroad Commission are urged to expand and intensify their activities in collecting, managing, and disseminating information on groundwater conditions and aquifer characteristics throughout Texas.

IV. The TWDB is urged to continue funding for updates to the groundwater availability models at least on a five-year basis, specifically the Groundwater Management Area 16 Groundwater Flow Model covering the Coastal Bend Region.

V. The Texas Legislature is urged to require the Texas Railroad Commission to cooperate with TWDB and TCEQ to encourage oil and gas well drillers to furnish e-logs, well logs, and other information and require logging of shallow, groundwater bearing formations to facilitate the better identification of aquifer characteristics.

VI. The Texas Legislature is urged to appropriate additional funds for TWDB to continue and expand their statewide groundwater data program and to appropriate new funds, through regional institutions such as Texas A&M University–Corpus Christi and Texas A&M University–Kingsville, for a regional research center to support research, data collection, monitoring, modeling, and outreach related to groundwater management activities in the Coastal Bend region of Texas.

VII. TCEQ is urged to amend rules and regulations to require routine water quality monitoring, by a non-partisan third-party, of mining operations and enforcement of water quality standards, including in situ mining and those with deep well injection practices.

VIII. The Texas Legislature is urged to prohibit in-situ mining in aquifers that serve as drinking water sources for residents and livestock.

XI. The Railroad Commission is urged to continue its identification of improperly plugged and abandoned oil and gas wells that adversely affect local groundwater supplies. Funding should be provided to address known problems and/or force responsible parties to properly plug abandoned wells, including oil, gas, and water wells.

X. The TWDB is urged to consider local mining projects (such as natural gas from the Eagleford shale) when developing mining water demand projections in the future for regional planning. The TWDB is urged to continue to provide guidance on how planning groups should address local mining water projects, especially those associated with gas production from the Eagleford shale or other projects with variable, and often indeterminate production timelines.

XI. Feasibility studies should be undertaken to identify opportunities/costs to develop regional groundwater systems that could utilize poor quality groundwater in conjunction with a desalination treatment plant to more effectively manage groundwater resources within the Coastal Bend Region.

XII. The Coastal Bend Region recognizes the importance of considering groundwater and surface water interaction when managing water resources and evaluating development of future water supplies. The Region encourages the Texas Legislature to provide funding for groundwater conservation districts and groundwater management areas to consider protection of springs and groundwater-surface water interaction when considering new DFCs.

8.1.5 Surface Water Management

I. The Texas Legislature is urged to provide funding for the development of periodic updates to surface water availability models, (WAMs), with specific consideration to updating the Nueces River Basin WAM through any new drought period.

II. The TCEQ is urged to enforce existing rules and regulations with respect to water impoundments.

III. Environmental studies of the segments of the Frio and Nueces Rivers downstream of Choke Canyon Reservoir to the Calallen Pool intakes should be undertaken to fully evaluate the potential impacts of reduced instream flows, including groundwater recharge.

8.1.6 Regional Water Resources Data Collection and Information Management

I. The Texas Legislature is urged to provide SB1 planning funds, through the Coastal Bend RWPG to a regional institution, to support regional water resources data collection and activities to develop and maintain a "Regional Water Resources Information Management System" for the Coastal Bend area.

8.1.7 Role of the RWPGs

I. The RWPG should play a role in facilitating public information/public education activities that promote a wider understanding of state and regional water issues and the importance of long-range regional water planning.

II. The Texas Legislature is urged to continue funding the TWDB to provide support for state mandated regional water planning group activities.

III. Public entities in the Coastal Bend Water Planning Region are urged to provide their share of continued funding for the administrative support activities that facilitate the Coastal Bend RWPG activities.

8.1.8 Water Quality

I. The Texas Legislature is urged to support studies to closely monitor discharges from sand and gravel operations in the Nueces River watershed and particularly Lower Nueces River.

II. Studies should be undertaken to analyze the effects/costs of new EPA Safe Drinking Water Act requirements regarding the treatment of problematic constituents in water on stakeholders and water users in the Coastal Bend Region.

8.2 Identification of River and Stream Segments Meeting Criteria for Unique Ecological Value

The Coastal Bend RWPG formed a subcommittee at an open meeting on February 7, 2019 to consider designating ecologically unique stream segments. The subcommittee met on April 23, 2019 to discuss and prepare such recommendations, which were adopted by the Coastal Bend Region on May 9, 2019.

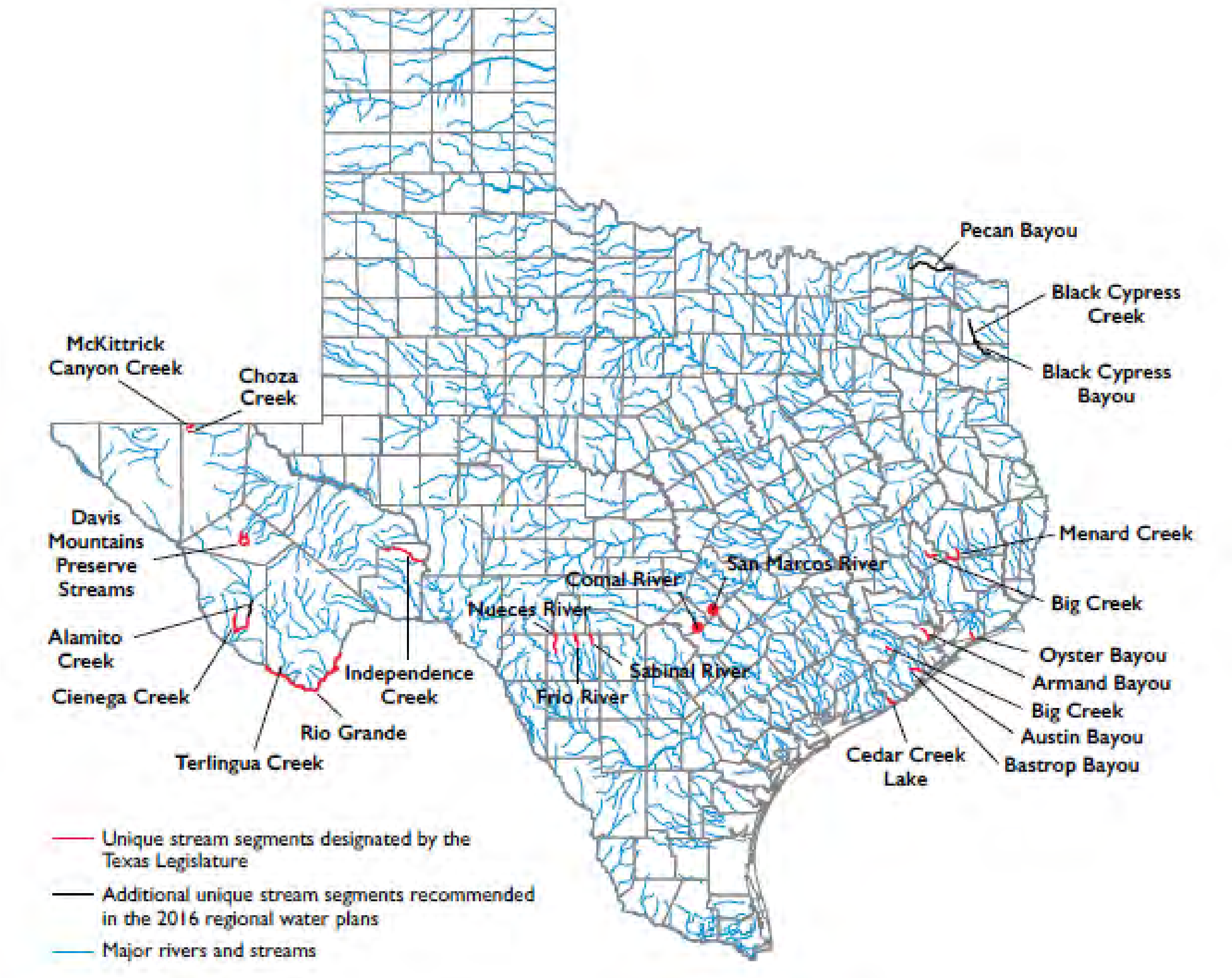
Planning groups may recommend the designation of river or stream segments of unique ecological value located within their planning area. The following criteria can be used as a basis for designating stream segments of unique ecological value: biological function, hydrologic function, riparian conservation areas, high water quality, exceptional aquatic life, high aesthetic value, and threatened or endangered species/unique communities.[1] The TWDB considers planning group recommendations of unique reservoir sites from adopted regional water plans when developing the State Water Plan.

According to Texas Water Code, Section 16.051, the State Water Plan is to include TWDB recommendations to the legislature for designation of river and stream segments of unique ecological value. If the legislature then designates a river or stream segment of unique value, it means that a state agency or political subdivision of the state may not finance construction of a reservoir on the designated river or stream segment.

The Coastal Bend Region considered TPWD's 2002 recommendations of four stream segments in Region N for designation of ecologically significant value: Aransas River Tidal (Segment 2003), Nueces River Tidal (Segment 2101), Nueces River (below Lake Corpus Christi) (Segment 2102),

[1] 31 Texas Administrative Code Chapter 358.2

and Nueces River (above Lake Corpus Christi) (Segment 2103).[2] In May 2019, the Coastal Bend Region recommended that no river or stream segments within the Coastal Bend Region be identified at this time. The unique stream segments of unique ecological value for protection recommended in the 2017 State Water Plan and designated by the Texas Legislature are presented in Figure 8.1. There are no river or stream segments in the Region N area designated by the 2017 State Water Plan or Texas Legislature as having unique ecological value.



Source: TWDB, Water for Texas 2017 State Water Plan.

Figure 8.1.
2017 State Water Plan - Designated and Recommended Unique Stream Segments

[2] Texas Parks and Wildlife, Ecologically Significant River and Stream Segments of Coastal Bend Water Planning Area (Region N), August 2002.

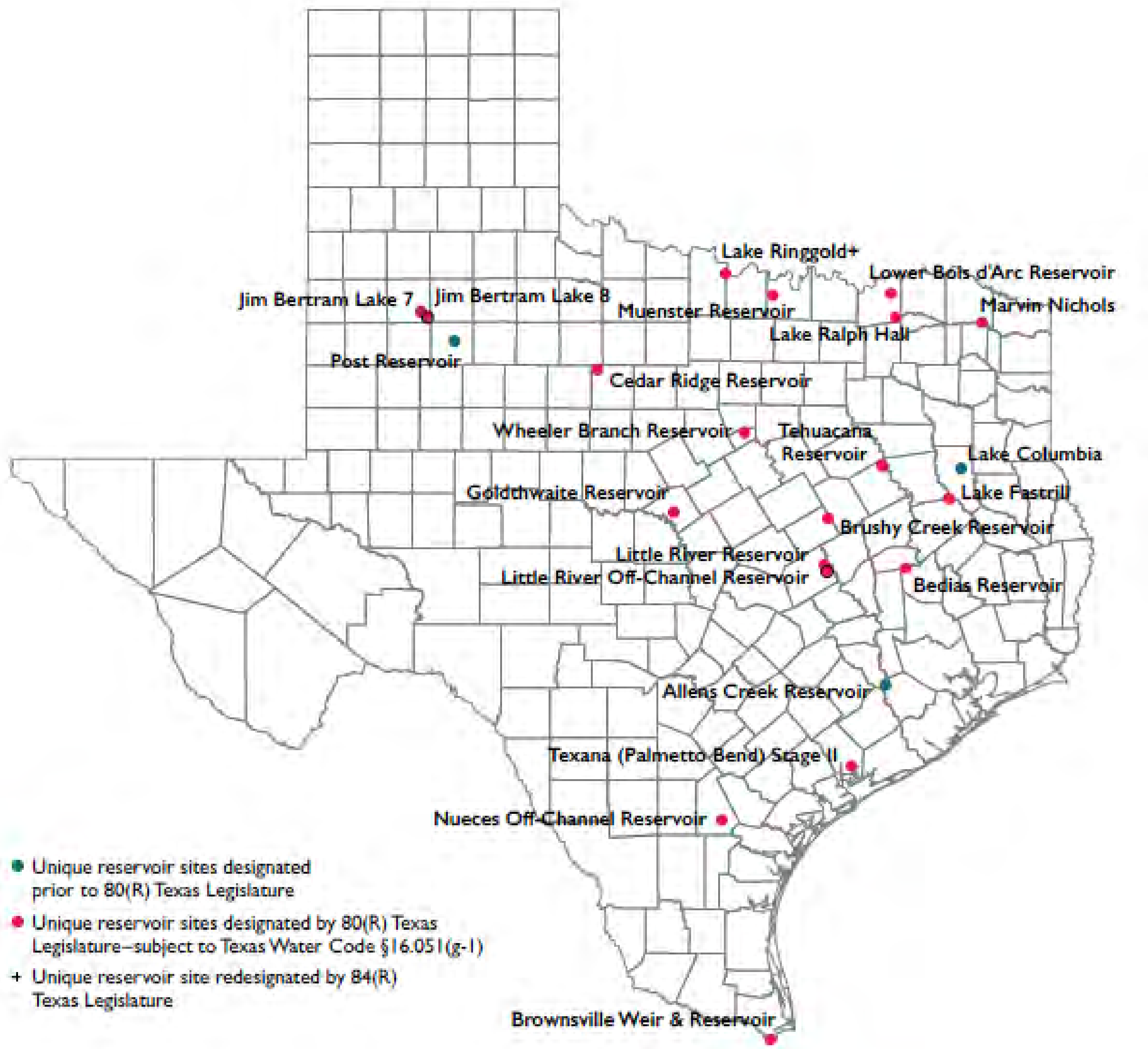
8.3 Identification of Sites Uniquely Suited for Reservoirs

Planning groups may recommend a site as unique for reservoir construction if: 1) site-specific reservoir development is recommended as a specific water management strategy or an alternative scenario in an adopted regional water plan; or 2) the site is uniquely suited to provide water supply for the current planning period or beyond 50-years. The TWDB considers planning group recommendations of unique sites for reservoir construction from adopted regional water plans when developing the State Water Plan.

According to Texas Water Code, Section 16.051, the State Water Plan is to include TWDB recommendations to the legislature for unique reservoir sites. If the legislature designates a site of unique value for the construction of a reservoir, a state agency or political subdivision of the state may not obtain a fee title or an easement that would significantly prevent the construction of a reservoir on a designated site.

The Coastal Bend RWPG formed a subcommittee at an open meeting on February 7, 2019 to consider designating reservoir sites of unique value for construction. The subcommittee met on April 23, 2019 to discuss previous designations by the Texas Legislature of reservoirs within or related to the Coastal Bend deemed uniquely suited and experience date by statute of those recommendations. Furthermore, feedback was provided by the City of Corpus Christi that they have no active plans to develop new reservoir supplies in the future. In May 2019, the Coastal Bend Region recommended that no unique reservoir sites in the Coastal Bend Region be identified at this time.

A map showing the 2017 State Water Plan recommended unique reservoir sites and those previously designated by the Texas Legislature as sites of unique value for reservoir construction is shown in Figure 8.2. Of these, 2 of the 26 sites were shown in the 2011 Region N Plan as recommended or alternative water management strategies to provide future supplies to the Coastal Bend Region: Nueces off-channel reservoir and Texana (Palmetto Bend) Stage II. Since the 2011 Region N Plan, both reservoirs have been removed from active study and further water supply for the Coastal Bend Region.



Source: TWDB, Water for Texas 2017 State Water Plan.

Figure 8.2.
2017 State Water Plan - Designated and Recommended Unique Reservoir Sites

The Lavaca Navidad River Authority (LNRA) is considering an off-channel variation of Stage II Lake Texana (Palmetto Bend) which was previously included in the 2016 Region N Plan, but removed from active study in this plan. The Coastal Bend Region supports initiatives by Region P and Lavaca Navidad River Authority (LNRA) regarding the Lavaca Off-Channel Reservoir Project. However, the Coastal Bend Region does not recommend specific tracts of land for the Lavaca Off-Channel Reservoir Project and encourages those wishing to pursue such options to discuss with property owners and mediate if necessary prior to Federal, State, or local recommendation of specific location(s).

8.4 Additional Recommendations

The following additional recommendations are provided by the Coastal Bend RWPG:

I. A detailed inventory of irrigation systems, crops, and acreage should be undertaken to more accurately estimate irrigation demands in the region.

II. The Coastal Bend Region requests additional clarification is provided by the Texas Legislature regarding the repercussions of identifying a stream segment as unique.

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9

Infrastructure Financing

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Chapter 9: Infrastructure Financing

9.1 Introduction

Senate Bill 2 (77th Texas Legislature) requires that regional water plans include a description of financing needed to implement recommended water management strategies and projects, including how local governments and others propose to pay for water management strategies identified in the plan. The TWDB issued an Infrastructure Financing Report (IFR) Survey requesting information from water user groups that have recommended water management strategies with capital costs during the 2021 regional water planning period from Year 2020 to 2070.

9.2 Objectives of the Infrastructure Financing Report

The primary objective of the Infrastructure Financing Report is to determine the financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any State funding sources considered).

9.3 Methods and Procedures

For the Coastal Bend Regional Water Planning Area, water user groups and wholesale water providers with recommended water management strategies that have capital costs in the regional plan were surveyed using a customized questionnaire provided by the TWDB. The TWDB prepared a spreadsheet and survey information for regional water planning groups to gather this information. IFR questionnaires were sent by the Coastal Bend Region directed to twenty three (23) municipal water user groups and major water providers.

For each project with an identified capital cost, the survey respondents were asked to enter only the amounts that they wish to receive from the TWDB program listed below:

- Planning, Design, and Permitting: Costs were entered into this category if the entity wanted to participate in the TWDB programs offering subsidized interest and deferral of principal and interest for planning, design, and permitting costs.
- Construction Funding: Costs were entered into this category if the entity wants to obtain subsidized interest for all construction costs, including planning, design, and construction.
- State Participation: Percentage of costs was entered into this category if the entity wanted to participate in the State Participation Program. State Participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

9.4 Survey Responses

The Coastal Bend RWPG emailed a survey package with supporting documentation to representatives for the following water user groups and major water providers: the City of Corpus Christi, San Patricio Municipal Water District, Nueces County WCID #3, the City of Alice, the City of Beeville, the City of Bishop, Nueces WSC, Port of Corpus Christi Authority, Poseidon Water and the City of Ingleside, Corpus Christi Naval Air Station, Falfurrias, Freer WCID, George West, Gregory, Naval Air Station Kingsville, Nueces County WCID 4, Orange Grove, Premont, Rockport, San Diego MUD, City of Sinton, TDCJ Chase Field, and the City of Three Rivers. Non-municipal water user groups at the county-level and municipal county-other did not receive surveys due to a lack of contact information appropriate for survey.

Comments were received from seven (7) water user groups who were sent the survey. Follow-up emails were sent to the remaining water user groups that received the survey.

As shown in Table 9.1, the 7 responses represent about 97 percent of the estimated capital costs of water management strategies included in the Regional Water Plan. Of those responding, for which total capital costs are around $3.17 billion the survey shows that approximately $2.55 billion, or 80%, would be sought through the state participation programs. The completed IFR survey collection spreadsheet requested by the TWDB is provided as an electronic appendix submitted separately alongside this Plan.

With respect to financing recommended water supply projects, as evident in survey responses. State participation is required in order to provide adequate funding for the implementation of water management strategies in the plan.

Table 9.1. Summary of Responses to the Infrastructure Financing Survey

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost[a]	Planning, Design, Amount	Planning, Design, Year of Need	Construction Funding Amount	Construction Funding Year of Need	Percent State Participation in Owning Excess
ALICE	Yes	CITY OF ALICE - BRACKISH GROUNDWATER DESALINATION	$23,983,000	$5,499,000	2019	$12,715,000	2021	0%
ALICE	Yes	CITY OF ALICE - NONPOTABLE REUSE	$10,222,000	$1,022,200	2022	$9,199,800	2023	0%
ALICE	Yes	MUNICIPAL CONSERVATION - ALICE	$4,862,000	$1,362,000	2021	$3,500,000	2022	0%
BEEVILLE	Yes	MUNICIPAL CONSERVATION - BEEVILLE	$3,991,000	$0	N/A	$3,991,000	2021	0%
BISHOP	Yes	MUNICIPAL CONSERVATION - BISHOP	$213,000	$0	N/A	$213,000	2022	0%
CORPUS CHRISTI	Yes	CITY OF CORPUS CHRISTI ASR	$90,199,000	$2,000,000	TBD	$8,000,000	TBD	0%
CORPUS CHRISTI	Yes	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)	$236,693,000	$11,475,000	2020	$211,000,000	2021	0%
CORPUS CHRISTI	Yes	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (LA QUINTA)	$420,372,000	$20,000,000	TBD	$250,000,000	TBD	0%
CORPUS CHRISTI	Yes	EVANGELINE/LAGUNA LP TREATED GROUNDWATER PROJECT	$78,775,000	TBD	TBD	TBD	TBD	TBD
CORPUS CHRISTI	Yes	O.N. STEVENS WTP IMPROVEMENTS	$53,940,000	not to be funded by State Programs				
CORPUS CHRISTI	Yes	MUNICIPAL CONSERVATION - CORPUS CHRISTI	$68,212,000	not to be funded by State Programs				
CORPUS CHRISTI NAVAL AIR STATION	No	MUNICIPAL CONSERVATION - CORPUS CHRISTI NAVAL AIR STATION	$2,560,000	No Response Received				
BEE COUNTY OTHER	No	GULF COAST SUPPLIES - BEE COUNTY OTHER	$4,943,000	No Response Received				
BROOKS COUNTY OTHER	No	GULF COAST SUPPLIES - BROOKS COUNTY OTHER	$1,207,000	No Response Received				
DUVAL COUNTY OTHER	No	GULF COAST SUPPLIES - DUVAL COUNTY OTHER	$2,109,000	No Response Received				
JIM WELLS COUNTY OTHER	No	GULF COAST SUPPLIES - JIM WELLS COUNTY OTHER	$10,704,000	No Response Received				
KENEDY COUNTY OTHER	No	MUNICIPAL CONSERVATION - COUNTY OTHER (KENEDY)	$503,000	No Response Received				
KLEBERG COUNTY OTHER	No	MUNICIPAL CONSERVATION - COUNTY OTHER (KLEBERG)	$51,000	No Response Received				
NUECES COUNTY OTHER	No	GULF COAST SUPPLIES - NUECES COUNTY OTHER	$4,514,000	No Response Received				
FALFURRIAS	No	MUNICIPAL CONSERVATION - FALFURRIAS	$3,423,000	No Response Received				
FREER WCID	No	MUNICIPAL CONSERVATION - FREER WCID	$1,070,000	No Response Received				
GEORGE WEST	No	MUNICIPAL CONSERVATION - GEORGE WEST	$207,000	No Response Received				
GREGORY	No	MUNICIPAL CONSERVATION - GREGORY	$55,000	No Response Received				
BEE COUNTY IRRIGATION	No	GULF COAST SUPPLIES - BEE IRRIGATION	$1,166,000	No Response Received				
BEE COUNTY IRRIGATION	No	IRRIGATION CONSERVATION - BEE COUNTY	$3,041,704	No Response Received				

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost[a]	Planning, Design, Amount	Planning, Design, Year of Need	Construction Funding Amount	Construction Funding Year of Need	Percent State Participation in Owning Excess
JIM WELLS COUNTY IRRIGATION	No	GULF COAST SUPPLIES - JIM WELLS IRRIGATION	$753,000	No Response Received				
JIM WELLS COUNTY IRRIGATION	No	IRRIGATION CONSERVATION - JIM WELLS COUNTY	$548,471	No Response Received				
LIVE OAK COUNTY IRRIGATION	No	GULF COAST SUPPLIES - LIVE OAK IRRIGATION	$917,000	No Response Received				
LIVE OAK COUNTY IRRIGATION	No	IRRIGATION CONSERVATION - LIVE OAK COUNTY	$676,687	No Response Received				
NUECES COUNTY IRRIGATION	No	GULF COAST SUPPLIES - NUECES IRRIGATION	$319,000	No Response Received				
NUECES COUNTY IRRIGATION	No	IRRIGATION CONSERVATION - NUECES COUNTY	$15,196	No Response Received				
SAN PATRICIO COUNTY IRRIGATION	No	GULF COAST SUPPLIES - SAN PATRICIO IRRIGATION	$420,000	No Response Received				
SAN PATRICIO COUNTY IRRIGATION	No	IRRIGATION CONSERVATION - SAN PATRICIO COUNTY	$7,829,259	No Response Received				
JIM WELLS COUNTY MANUFACTURING	No	GULF COAST SUPPLIES - JIM WELLS MANUFACTURING	$129,000	No Response Received				
KLEBERG COUNTY MANUFACTURING	No	GULF COAST SUPPLIES - KLEBERG MANUFACTURING	$852,000	No Response Received				
LIVE OAK COUNTY MANUFACTURING	No	GULF COAST SUPPLIES - LIVE OAK MANUFACTURING	$188,000	No Response Received				
BEE COUNTY MINING	No	GULF COAST SUPPLIES - BEE MINING	$622,000	No Response Received				
BROOKS COUNTY MINING	No	GULF COAST SUPPLIES - BROOKS MINING	$615,000	No Response Received				
DUVAL COUNTY MINING	No	GULF COAST SUPPLIES - DUVAL MINING	$3,228,000	No Response Received				
JIM WELLS COUNTY MINING	No	GULF COAST SUPPLIES - JIM WELLS MINING	$202,000	No Response Received				
KENEDY COUNTY MINING	No	GULF COAST SUPPLIES - KENEDY MINING	$469,000	No Response Received				
KLEBERG COUNTY MINING	No	GULF COAST SUPPLIES - KLEBERG MINING	$638,000	No Response Received				
NUECES COUNTY MINING	No	GULF COAST SUPPLIES - NUECES MINING	$2,200,000	No Response Received				
SAN PATRICIO COUNTY MINING	No	GULF COAST SUPPLIES - SAN PATRICIO MINING	$1,141,000	No Response Received				
NAVAL AIR STATION KINGSVILLE	No	MUNICIPAL CONSERVATION - NAVAL AIR STATION KINGSVILLE	$716,000	No Response Received				
NUECES COUNTY WCID 3	No	LOCAL BALANCING STORAGE RESERVOIR	$21,575,000	No Response Received				
NUECES COUNTY WCID 3	No	MUNICIPAL CONSERVATION - NUECES COUNTY WCID 3	$7,316,000	No Response Received				
NUECES COUNTY WCID 4	No	MUNICIPAL CONSERVATION - NUECES COUNTY WCID 4	$5,640,000	No Response Received				

Sponsor Entity Name	Received Response to Survey	ProjectName	Capital Cost[a]	Planning, Design, Amount	Planning, Design, Year of Need	Construction Funding Amount	Construction Funding Year of Need	Percent State Participation in Owning Excess
NUECES WSC	Yes	MUNICIPAL CONSERVATION - NUECES WSC	$177,000	$0	N/A	$177,000	2022	0%
ORANGE GROVE	No	MUNICIPAL CONSERVATION - ORANGE GROVE	$1,153,000	No Response Received				
PORT OF CORPUS CHRISTI AUTHORITY	Yes	PORT OF CORPUS CHRISTI AUTHORITY - HARBOR ISLAND	$802,807,000	$160,561,400	2030	$642,245,600	2030	0%
PORT OF CORPUS CHRISTI AUTHORITY	Yes	PORT OF CORPUS CHRISTI AUTHORITY - LA QUINTA CHANNEL	$457,732,000	$91,546,400	2030	$366,185,600	2030	0%
POSEIDON WATER/ INGLESIDE	Yes	POSEIDON REGIONAL SEAWATER DESALINATION AT INGLESIDE	$724,984,000	$15,000,000	2022	$616,236,400	2025	40%
PREMONT	No	MUNICIPAL CONSERVATION - PREMONT	$1,504,000	No Response Received				
ROCKPORT	No	MUNICIPAL CONSERVATION - ROCKPORT	$1,751,000	No Response Received				
SAN DIEGO MUD 1	No	GULF COAST SUPPLIES - SAN DIEGO MUD 1	$1,856,000	No Response Received				
SAN DIEGO MUD 1	No	MUNICIPAL CONSERVATION - SAN DIEGO MUD 1	$538,000	No Response Received				
SAN PATRICIO MWD	Yes	EVANGELINE/LAGUNA LP BRACKISH GROUNDWATER PROJECT	$78,775,000	$11,550,200	2030	$103,951,800	2030	0%
SAN PATRICIO MWD	Yes	REGIONAL INDUSTRIAL WASTEWATER REUSE PLAN (SPMWD)	$115,502,000	No Response Received				
SINTON	No	MUNICIPAL CONSERVATION - SINTON	$2,137,000	No Response Received				
TDCJ CHASE FIELD	No	GULF COAST SUPPLIES - TDCJ CHASE FIELD	$703,000	No Response Received				
TDCJ CHASE FIELD	No	MUNICIPAL CONSERVATION - TDCJ CHASE FIELD	$1,947,000	No Response Received				
THREE RIVERS	No	MUNICIPAL CONSERVATION - THREE RIVERS	$183,000	No Response Received				

[a] Consistent with capital costs shown in plan.
N/A= Not applicable
TBD= To Be Determined, at later time by Sponsor.

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10

Public Participation and Plan Adoption

[31 TAC § 357.12;
31 TAC § 357.21;
31 TAC § 357.50;
31 TAC § 358.3]

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Chapter 10: Public Participation, Adoption, Submittal, and Approval of Regional Plan

10.1 Public Involvement Program

The public involvement program was incorporated at the onset of the Coastal Bend Regional Water Planning Group (CBRWPG) water planning process in order to maximize the opportunity for public review and input into the process of developing the water plan as well as providing comments on the Initially Prepared Regional Water Plan.

The public involvement program included:

- An opportunity at all RWPG meetings for the public to comment on any aspect of the plan or planning process;
- Press releases and notices of public meetings; and
- Dedicated website for CBRWPG information.
- Public Hearing for Initially Prepared Plan:
  Tuesday, June 2, 2020 5:30 PM
  Web-Ex Virtual Meeting (per Governor's orders)

The CBRWPG conducted all business in meetings that were posted according to Texas Open Meetings Act and Public Information Act provisions. The plan was developed in accordance with Texas Administrative Code public participation requirements specified in 31 TAC §357.12, §357.21, and §357.50(f).

Comments received on the Initially Prepared Plan and responses to comments are included in Appendix F.

10.2 Coordination with Wholesale and Major Water Providers

Information was provided by wholesale water providers located in the Coastal Bend Planning Region throughout development of the plan. Wholesale water providers were contacted to confirm water supplies and future water supply plans prior to identifying feasible water management strategies. Furthermore, wholesale water providers were provided water supply plan information from the technical consultant for review and comment prior to providing to the CBRWPG for consideration.

Representatives from water supply entities within the CBRWPG were also regularly notified of all CBRWPG meetings and public informational meetings.

10.3 Coastal Bend Regional Water Planning Group Meetings

The CBRWPG regularly met in accordance with the approved bylaws. The CBRPWG met on a more frequent basis as needed in order to facilitate and direct the water planning of the region. The following is a summary of the meetings:

Coastal Bend RWPG Meetings	
April 14, 2016	February 7, 2019
September 8, 2016	May 9, 2019
January 19, 2017	September 19, 2019
August 10, 2017	November 14, 2019
November 9, 2017	January 16, 2020
February 8, 2018	February 20, 2020
May 10, 2018	September 3, 2020
August 9, 2018	September 24, 2020

The CBRWPG requested that the TWDB execute the initial contract to develop the 2021 Coastal Bend Regional (Region N) Water Plan on January 15, 2015. Consistent with by-laws, the CBRWPG elected not to re-procure for the 2021 planning cycle and selected HDR Engineering as the technical consultant for development for the 2021 Region N Plan on March 12, 2015.

The CBRWPG accepted public and wholesale water provider input on topics to address or consider during the 2017-2021 planning cycle on April 16, 2016 and subsequently issued a letter to the TWDB related to region-specific issues in Region N.

The CBRWPG also designated several subcommittees in order to expedite more specific work efforts and further increase the effectiveness and timeliness of the planning process. The following summarizes these committee and subcommittee meetings.

Review Population, Municipal and Mining Water Demand Projections

- Subcommittee Members: Teresa Carrillo, Carl Crull, and Carola Serrato.
- Designated by the CBRWPG: January 19, 2017
- Subcommittee meeting: April 6, 2017

Review Non-municipal Water Demand Projections (Manufacturing, Steam-Electric, Irrigation, Livestock

- Subcommittee Members: Scott Bledsoe, John Burris, Pancho Hubert, Robert Kunkel, Charles Ring, Carola Serrato, and Mark Scott.
- Designated by the CBRWPG: August 10, 2017
- Subcommittee meeting: September 7, 2017

Consider Use of MAG Peak Factors for Groundwater Availability

- Subcommittee Members: Scott Bledsoe, Chuck Burns, Andy Garza, Luis Peňa, Charles Ring, Felix Saenz, Carola Serrato, and Lonnie Stewart.
- Designated by the CBRWPG: November 9, 2017
- Subcommittee meeting: February 28, 2018

Develop and Review List of Potentially Feasible Water Management Strategies and Prioritize for Evaluation

- Subcommittee Members: Scott Bledsoe, Carl Crull, Carola Serrato, Mark Scott, and Jace Tunnell.
- Designated by the CBRWPG: May 10, 2018
- Subcommittee meeting: June 27, 2018

Subcommittee to Identify Emergency Interconnections/Drought Response Recommendations

- Subcommittee Members: Scott Bledsoe, Teresa Carrillo, Carola Serrato, and Mark Scott.
- Designated by the CBRWPG: February 7, 2019
- Subcommittee meeting: April 3, 2019

Subcommittee on Unique Stream Segments/Reservoir Sites and Legislative and Policy Recommendations

- Subcommittee Members: Scott Bledsoe, Teresa Carrillo, Carl Crull, and Carola Serrato.
- Designated by the CBRWPG: February 7, 2019
- Subcommittee meetings: April 3, 2019 and July 23, 2020

Subcommittee on Unique Stream Segments/Reservoir Sites and Legislative and Policy Recommendations

- Subcommittee Members: Scott Bledsoe, Teresa Carrillo, Carl Crull, and Carola Serrato.
- Designated by the CBRWPG: February 7, 2019
- Subcommittee meeting: April 3, 2019

Subcommittee for Prioritization of Recommended Water Management Strategy Projects for the 2021 Regional Water Plan

- Subcommittee Members: Scott Bledsoe, Teresa Carrillo, Pancho Hubert, Lonnie Stewart, and Carola Serrato.
- Designated by the CBRWPG: February 20, 2020
- Subcommittee meeting: July 23, 2020

The CBRWPG approved the Final Plan on September 24, 2020 for submittal to the Texas Water Development Board.

10.4 Regional Water Planning Group Chairs Conference Calls and Meetings

The Texas Water Development Board held conference call meetings with Regional Water Planning Group chairs to provide guidance and respond to issues regarding the planning process on January 26, 2016, August 26, 2016, January 12, 2017, June 28, 2017, May 8, 2018, October 22, 2018, January 29, 2019, August 28, 2019, January 27, 2020, and September 10, 2020.

10.5 Coordination with Other Regions

Several coordination calls between the CBRWPG technical consultant and Lavaca RWPG and the South Central Texas RWPG consultants occurred during development of the initially prepared plan.

There are no known interregional coordination conflicts for any recommended or alternative water management strategies in the 2021 Coastal Bend Plan.

10.6 Coordination with Other Entities

Frequent coordination calls occurred between the technical consultant and wholesale water providers and individual water user groups to confirm water supplies and future water supply plans.

Emails were sent to WUGs and WWPs in January 2020 with follow-up phone calls to gather information on implementation of recommended water management strategies from the 2011 Plan (Chapter 11), as well as from July through August 2020 to gather information for Infrastructure Financing of recommended water management strategy projects (Chapter 9).

11

Implementation and Comparison to Previous Regional Water Plans

[31 TAC §357.45]

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Chapter 11: Implementation and Comparison to Previous Regional Water Plans

11.1 Implementation of Previous Regional Water Plan

In response to Senate Bill 660 (82nd Legislative Session), the TWDB issued guidance for each region to report the level of implementation of previously recommended WMS and associated impediments to constructing water projects to meet future water needs in accordance with 31 TAC §357.45(a).

The 2016 Region N Plan included 46 recommended WMS, of which 28 (or 61% of the total strategies) were related to voluntary water conservation. Emails and follow-up phone calls were placed to WUGs and WWPs to gather information on the implementation status of recommended WMS presented in the 2016 Region N Plan and preliminary results were discussed at the CBRWPG meeting on January 16, 2020. Information requested was based on the TWDB survey spreadsheet needs including the project description, infrastructure type, actions towards supply development, impediments affecting implementation, project phasing, and impacts (if any) on flood control. The WUGs and WWPs were asked to provide an update on the level of implementation currently achieved, the initial volume of water provided, funds expended to date, project cost, funding source and year the project went online. If the project was a phased project, the WUGs were asked about the ultimate volume, project cost, and year that the project will reach maximum capacity. If the project was not implemented, the WUGs were asked to comment on why that was the case. The survey also had a spreadsheet input field regarding inclusion in the 2021 plan for both phased and non-implemented projects.

Comments were received from four WUG/WWPs representatives by February 1, 2020, representing 16 of the 46 WMSs that were recommended in the 2016 Plan. Water conservation plans were reviewed to provide updates for an additional 21 municipal water conservation strategies, thus totaling a status update for 37 of the 46 recommended strategies. Results of the survey are summarized in Table 11.1. There are five recommended WMSs, other than water conservation, from the 2016 Region N Plan that have been implemented: Chase Well Field (Beeville), SPMWD Industrial WTP improvements, additional Carrizo Well for McMullen County- Mining, Minor Aquifer Development for McMullen County- Mining, and Gulf Coast Aquifer Development for San Patricio County- Irrigation. The following water management strategies have not been implemented due to changed conditions: Gulf Coast Aquifer Development for McMullen County-Mining and Irrigation, STWA Interconnections for the City of Alice, and Portland Reuse Pipeline. Others are in various stages of project advancement ranging from the sponsor has taken official action to initiate the project to an ongoing feasibility study to projects being under construction.

The Coastal Bend Regional Water Planning Group completed the TWDB-provided survey spreadsheet to gather and record this information, along with other project-related details, and the information gathered as of February 1, 2020 is included in Appendix E.

Table 11.1. Summary of Project Implementation

Responding Entity	WUG/WWP	Projects Implemented	Projects Under Construction	Projects in Design Phase	Feasibility Study Ongoing
Alice	City of Alice	0	0	1	3
San Patricio Municipal Water District	Manufacturing - San Patricio County	2	0	0	0
Local GCD representative	Mining, McMullen	2	0	0	1
Local GCD representative	Irrigation, McMullen	1	0	0	0
Local GCD representative	Irrigation, San Patricio	2	0	0	0

11.2 Comparison to Previous Regional Water Plan

The TWDB guidance and TAC Chapter 357.45(b) require that the 2021 Region N Plan briefly summarizes differences from the previously adopted 2016 Region N Plan.

11.2.1 Water Demand Projections

The total water demand projected for the region in the 2021 Region Plan is 8,752 ac-ft less (a reduction of 3%) than in the 2016 Region N Plan. In subsequent decades, the 2021 Plan shows appreciably lower water demands, with 2070 water demands being 66,752 ac-ft less (a reduction of 19%) as compared to the 2016 Plan. Much of this is attributed to a change in the TWDB methodology for projecting non-municipal water demands for the 2021 Plan by keeping industrial water demands constant after 2030. **The projected water demand reduction from the 2016 Plan projections is not consistent with local water supply plans that indicate industrial growth, and for this reason additional water management strategies are recommended for a total amount that exceeds needs calculated based on TWDB projections.** Figure 11.1 compares water demand projections from the 2021 Region N Plan to previous 2016 Region N Plan/ 2017 State Water Plan projections. For the 2021 Region N Plan, municipal projections generally increased by about 3% for each decade from 2020 through 2070. Irrigation increased for Year 2020, but then decreased for subsequent decades as compared to the 2016 Region N Plan estimates. Manufacturing, steam-electric, and livestock projections for the 2021 Region N Plan are all lower than those from the 2016 Region N Plan/2017 State Water Plan. The largest reduction is in steam-electric projections ranging from 11,042 to 30,545 acre-feet per year (ac-ft/yr) lower for the 2021 Region N Plan as compared to the previous planning cycle.

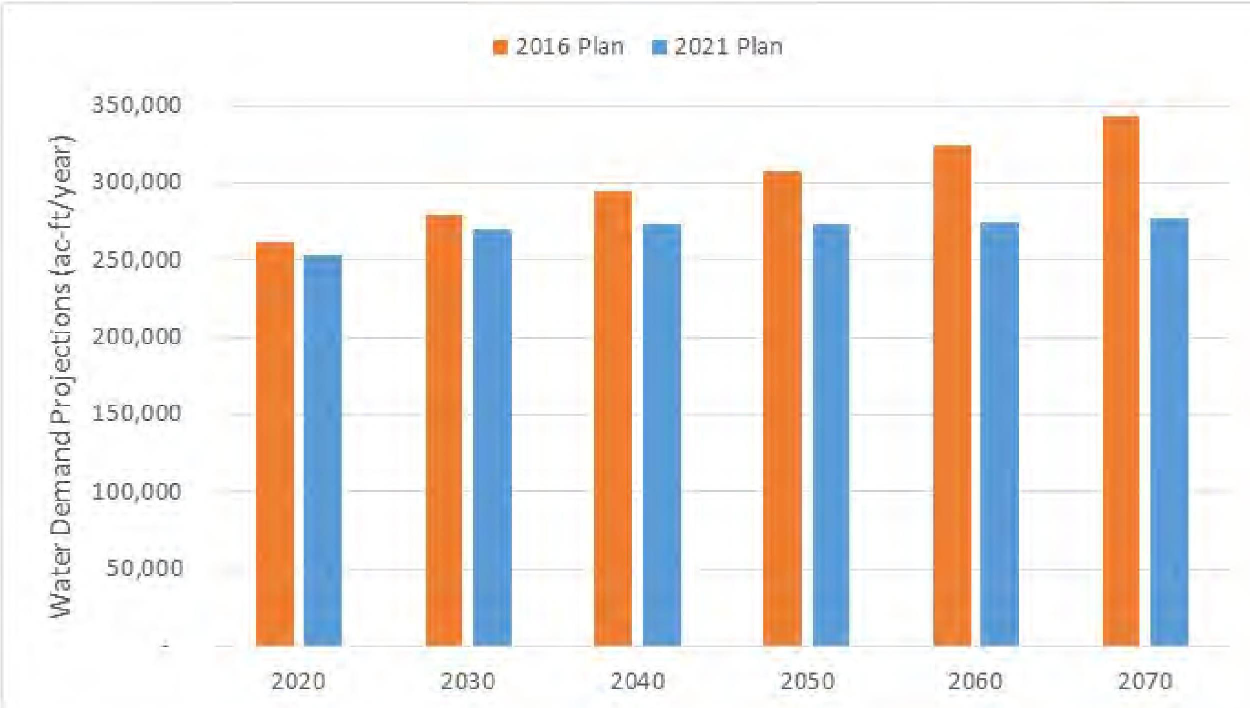

Figure 11.1.
Comparison of Region N Water Demand Projections from 2021 Plan and Previous 2016 Plan, Combined Demands for all Use Types

In the 2016 Plan, the total water demands for all entities in the region were projected to increase from 261,970 ac-ft/yr in 2020 to 343,244 ac-ft/yr in 2070. The total water demand projections for the 2021 Plan increase from 253,218 ac-ft/yr in 2020 to 276,492 ac-ft/yr in 2070. For the 2021 Plan, municipal water demands represent between 45-48% of the overall water demand in the region through 2070 as compared to 37-43% of the overall water demand in the 2016 Plan. Of the remaining projected water demand which is attributed to non-municipal users (manufacturing, steam-electric, irrigation, mining, livestock), 65% is projected to occur within the manufacturing sector in 2020 increasing to 70% by 2070. Most of this is attributable to manufacturing in Nueces and San Patricio Counties.

Manufacturing demands account for 36 percent of total water demands in 2070. The majority of these demands, 99 percent, are in Nueces and San Patricio Counties. Jim Wells, Kleberg, and Live Oak Counties make up the remaining 1 percent. The regional mining demand, 5,497 ac-ft, accounts for only 2 percent of total demand in 2070. Irrigation demand remains constant at 30,206 ac-ft over the 50-year planning period and in 2070 represents 11 percent of total demand.

11.2.2 Drought of Record and Hydrologic and Modeling Assumptions

For previous Region N Plans, the drought of record in the Lower Nueces Basin was identified as the drought of the 1990s, which was the most severe from 1992-1996. The most recent drought beginning in 2007 had been discussed in the 2016 Region N Plan as potentially being a new drought of record but for several reasons, including that the Corpus Christi Water Supply Model hydrology period extent from 1934 to 2003 did not cover this period, a new drought had not been confirmed at the time of plan submittal in December 2015.

For the 2021 Plan, the Corpus Christi Water Supply Model was updated to include recent hydrology for the Nueces Basin through 2015 for a total model period of 82 years (1934 to 2015). Additional model updates included extending recent hydrology for Lake Texana and the Colorado River (for Mary Rhodes Phase II supplies) through 2015 and incorporating new TWDB volumetric survey data for Lake Corpus Christi (2016), Choke Canyon Reservoir (2012), and Lake Texana (2010) and associated updated sedimentation rates.

The updated Corpus Christi Water Supply Model included a 82 year hydrology period through 2015, inclusion of recent MRP Phase II supply, updates for the City's reservoir system operations, and LNRA call-back exercised for a portion of Lake Texana contracted supplies. The model was used to evaluate recent drought conditions to identify a new historic drought of record within the planning area. Average annual inflows to Lake Corpus Christi and Choke Canyon System continue to trend lower with each successive drought, with the most recent hydrology update[1] for the Corpus Christi Water Supply Model (through 2015) showing a *new drought of record for the Corpus Christi Regional Water Supply System from 2007 to 2013*. The critical month of the drought of record, the basis of the Corpus Christi Regional Water System current system yield, occurred in September 2013.

At the August 10, 2017 CBRWPG meeting, the planning group considered guidance from the TWDB to consider firm yield when determining surface water availability. Based on the regional water supply system being prone to severe drought and a new drought of record from 2007 to 2013, the CBRWPG approved a safe yield approach based on maintaining a 75,000 ac-ft reserve in storage during the worst, historical drought of record. Safe yield is a standard approach that the CBRWPG and the City of Corpus Christi have consistently used in previous planning cycles as a provision for climate and growth uncertainty, such that a specified reserve amount remains in storage during the modeled critical drought.

The CBRWPG submitted two hydrologic variance requests to the TWDB on September 22, 2017 which were approved by the TWDB on January 5, 2018 to (1) use the Corpus Christi Water Supply Model for determining surface water availability for the CCR/LCC/Texana/MRP Phase II system (2) report water availability for the multi-basin regional supply as a system rather than individual reservoirs and (3) use of safe yield as the basis for determining availability for the Corpus Christi Regional Water Supply System.

A comparison of water modeling assumptions for the 2021 Region N Plan to previous plans is included in Table 11.2.

[1] Corpus Christi Water Supply Yield Results from Hydrology Update, June 1, 2017.

Table 11.2.
Comparison of Water Modeling Assumptions Used to Develop the 2021 Plan and Previous Coastal Bend Regional Water Plans

2021 Plan	2016 Plan	2011 Plan
Groundwater Availability based on **Modeled Available Groundwater**	Groundwater Availability based on **Modeled Available Groundwater**	Groundwater Availability based on **Central Gulf Coast GAM analyses and CBRWPG-adopted criteria for acceptable drawdown and water quality**
Corpus Christi Water Supply Model updated to include hydrology from 1934-2015. Current Supply from CCR/LCC/Lake Texana/**MRP Phase II** System based on Corpus Christi Water Supply Model safe yield analysis (**75,000 ac-ft storage reserve**) for the City of Corpus Christi and its customers only	MRP Phase II added. Existing Supply from CCR/LCC/Lake Texana/**MRP Phase II** System based on Corpus Christi Water Supply Model safe yield analysis (**12 month storage reserve**) for the City of Corpus Christi and its customers only	Existing Supply from CCR/LCC/Lake Texana System based on Corpus Christi Water Supply Model safe yield analysis (**6 month storage reserve**) for the City of Corpus Christi and its customers only
Run of the river water rights in the Nueces Basin, firm yield supplies based on minimum annual supply that could be diverted **limited by minimum month conditions**. No return flows from Region L.	Run of the river water rights in the Nueces Basin, firm yield supplies based on minimum annual supply that could be diverted **limited by minimum month conditions**. Return flows from Region L.	Run of the river water rights in the Nueces Basin, firm yield supplies based on minimum annual supply that could be diverted.
New Surface WMSs conform to TCEQ Environmental Flow Standards	New Surface WMSs conform to TCEQ Environmental Flow Standards	New Surface WMSs conform to **2001 Agreed Order Provisions or Consensus Criteria for Environmental Flow Needs**

11.2.3 Water Availability, Existing Supplies, and Identified Water Needs

Nearly 75% of the water used in the region comes from surface water supplies originating from the CCR/LCC/Texana/MRP Phase II system. In the 2016 Plan, the Corpus Christi Regional Water Supply System (CCR/LCC/Texana/MRP Phase II system) showed an annual safe yield of 219,000 ac-ft in 2020 declining to 214,000 ac-ft in 2070. For the 2021 Region N Plan, the Corpus Christi Regional Water Supply System (CCR/LCC/Texana/MRP Phase II system) has an annual safe yield of 178,000 ac-ft in 2020 declining to 167,000 ac-ft in 2070 due to sedimentation.

The surface water availability decreased in the 2021 Plan as compared to 2016 Plan attributed primarily to a new drought of record in the Nueces Basin (2007 to 2013), updated volumetric surveys showing higher sedimentation rates for Choke Canyon Reservoir and Lake Corpus Christi, and LNRA call-backs of a portion of Lake Texana supplies. With the updated model, safe yield reserve was changed from 125,000 ac-ft reserve (roughly equal to 1 year supply) in the 2016 Region N Plan to a 75,000 ac-ft reserve for the 2021 Plan.

Surface water availability for all other surface water rights, including run of the river rights, is based on WAM Run 3. Pursuant to TWDB guidance "Run of river availability, or firm diversion, evaluated for a municipal sole-source water use, is defined as the minimum monthly diversion amount that is available 100% of the time during a repeat of the drought of record (i.e., this minimum volume must be available each and every month)." For surface water withdrawals that do not require permits, such as for livestock purposes, Region N estimated local annual water availability volumes under drought of record conditions based on current water use data provided by the TWDB. For Nueces County WCID # 3, who has a senior run-of-the-river water right on the Nueces River downstream of Lake Corpus Christi, a firm yield of 1,955 ac-ft/yr was shown in the 2016 Region N Plan. For the 2021 Region N Plan, the Nueces County WCID # 3 firm yield is lower, at 384 ac-ft/yr from 2020 to 2070. The reduced yield is attributed to removal of Region L return flows that were previously approved by the TWDB as a variance and included in the 2016 Plan but removed during 2021 South Texas Regional Water Plan development consistent with TWDB guidance.

The modeling assumptions used to develop groundwater availability for the 2021 Plan are the same as those used for the 2016 Plan. Groundwater availability was limited to MAGs developed based on DFCs provided by GMA/GCDs within the Coastal Bend Region, but the 2021 Plan MAGs have been updated with new information since development of the 2016 Plan. The 2016 Plan groundwater availability based on MAGs is approximately 227,000 ac-ft and was constant from 2020 to 2070. The 2021 Plan groundwater availability based on MAGs increases from 145,269 ac-ft in 2020 to 187,096 ac-ft in 2070. Overall most counties showed lower MAGs as compared to the 2021 Plan, with Kleberg and Kenedy counties showing over 20,000 ac-ft and over 30,000 ac-ft, respectively, less than in the previous 2016 Plan. However, the San Patricio County MAG showed an increase of about 25,000 ac-ft in the 2021 Plan as compared to the 2016 Plan.

Existing water supplies for Region N entities have changed significantly since the last planning cycle. Surface water supplies were determined for most surface water users based on safe yield of the Corpus Christi Regional Water Supply System using an updated model that includes a recent, new drought of record. For Nueces County WCID 3 and River Acres WSC, the firm yield of run-of-the-river rights was used for current supply. There are no known infrastructure constraints that would preclude these supplies from being delivered at the safe or firm yield capacity, respectively. Groundwater supplies in the 2021 Region N Water Plan are based on MAG projections provided by the TWDB, constrained by well capacity as reported in TCEQ PWS database. For non-municipal groundwater users with groundwater capacities that are not readily obtained from publicly available sources, the groundwater supply was calculated based on TWDB historical water use records.

Municipal supplies have decreased on average by 15,000 ac-ft/yr for the entire 50 year period from 2020 through 2070. Non-Municipal WUG supplies have decreased on an average of 69,000 ac-ft/yr over the same five planning period. Some of this is due to groundwater supplies being limited to average day well capacity according to MAGs, but most is attributable to revised surface water availability and supplies based on new drought of record conditions and changes in volumetric surveys for LCC and CCR. Since most of the expected industrial growth occurs in San Patricio and Nueces counties, the regional CCR/LCC/Texana/MRP Phase II can accommodate flexibility in delivery of these supplies subject to physical delivery constraints and contract provisions. Overall the total difference in existing supplies between planning cycles range from a reduction of 68,323 ac-ft in 2020 to a reduction of 99,140 ac-ft in 2070.

Municipal and non-municipal need projections are higher in the 2021 Plan due to supply constraints discussed previously. When comparing total available supplies to total demands for the 2021 Region N Plan, the region shows a water supply need throughout the 50-year planning cycle. Beginning in 2020 a shortage of 13,530 ac-ft exists within the Region and increases to 49,363 ac-ft by 2070. The previous 2016 Plan showed regional needs amounting to 34,538 ac-ft in 2070.

On a regional basis, municipal and industrial entities (Manufacturing, Steam-Electric, and Mining) show increasing needs from 12,247 ac-ft in 2020 to 47,889 ac-ft in 2070, due primarily to decreasing manufacturing surface water availability accompanied by increasing manufacturing demand beginning in 2030. Shortages based on current supplies provided by the CCR/LCC/Texana/MRP Phase II System were placed on industrial (mining and/or manufacturing) demands in San Patricio and Nueces Counties. Surface water supplies provide 94 percent of total manufacturing supplies in 2070 with groundwater comprising the remaining 6 percent. Region-wide there is a manufacturing supply deficit of 16,434 ac-ft in 2030 increasing to 34,441 ac-ft by 2070.

11.2.4 Recommended and Alternative Water Management Strategies and Projects

The Coastal Bend Regional Water Planning Group has studied numerous water management strategies as part of previous regional water planning efforts as summarized in Table 11.3. Many of these strategies are no longer actively being considered by local sponsors and, therefore, were not evaluated as part of the 2021 Regional Water Plan.

The 2021 Region N Regional Plan reflects water management strategies identified through conversations with wholesale water providers, water user groups, and potential new providers to address anticipated industrial growth in the Coastal Bend Region. During the development of this plan, cooperation has been encouraged between wholesale water providers and water user groups for the purpose of achieving economies of scale and pursuing strategies that benefit the entire region.

Table 11.3. Summary of Water Management Strategies from Previous Coastal Bend Regional Water Plans

Water Management Strategies	2001 Plan	2006 Plan	2011 Plan[A]	2016 Plan	2021 Plan
Recommended Strategies (2001, 2006, or 2011 Plan)					
Municipal Water Conservation	√	√	√	√	√
Irrigation Water Conservation	√	√	√	√	√
Manufacturing Water Conservation and Nueces River Water Quality Issues	√	√	√	√	√
Mining Water Conservation		√	√	√	√
ON Stevens WTP Improvements			√	√	√
SPMWD Industrial WTP Improvements				√	
Reclaimed Wastewater Supplies and Reuse[B]		√	√	√	√
Gulf Coast Aquifer Supplies	√ [C]	√	√	√	√
Modify Existing Reservoir Operating Policy[B]		√ [D]	√ [D]	√	
CCR and LCC Pipeline[B]		√ [E]	√ [G]		
Voluntary Redistribution of Available Supplies (and Federal or State Opportunities to Participate in Regional Projects)	√	√ [F]	√ [F]	√ [H]	
Nueces Off-Channel Reservoir near Lake Corpus Christi		√	√		
Stage II of Lake Texana[B]		√	√ [G]		
Lavaca River Diversion and Off-Channel Reservoir			√	√	
Garwood Pipeline (and other interbasin transfers)	√	√	√		
Seawater Desalination	√	√	√ [G]	√	√
Brackish Groundwater Desalination			√ [G]	√	√
Potential Water System Interconnections	√			√	
Interruptible Lake Texana Supplies (2001 Plan)	√				
Recycle and Reuse of Groundwater or Use of Non-Potable Supplies (for Mining Water Users)	√				
Aquifer Storage and Recovery (ASR)	√	√			√
Local Balancing Storage Reservoir (Nueces County WCID #3)				√	√
GBRA Lower Basin Storage Project				√	
Studied and Considered (Not Recommended in 2001, 2006, or 2011 Plans)					
Carrizo-Wilcox Aquifer Supplies	√	√	√		
Sediment Removal in Lake Corpus Christi	√				
Brush Management	√	√	√		
Weather Modification	√	√	√		
Water Quality (TDS Study) - Lake Corpus Christi, Lake Texana, and Calallen Pool			√		

[A] The 2011 Plan also included five (5) special studies related to water supply development.
[B] Studied and considered in the 2001 Plan, but not recommended.
[C] Included short-term overdrafting in the 2001 Plan for generally small groundwater needs.
[D] Safe yield analysis was recommended strategy in 2006 and 2011 Plans.
[E] CCR/LCC Pipeline was revised from 2-way pipeline (in 2001 Plan) to 1-way pipeline from CCR to LCC.
[F] Includes USCOE Nueces Feasibility Study project opportunities.
[G] Considered an alternative water management strategy in the 2011 Plan.
[H] Voluntary Redistribution of Available Supplies included in Gulf Coast Aquifer Supplies (5D.7) for the 2016 Plan. Federal or State Opportunities to Participate in Regional Projects was not included in the 2016 Plan.

11.3 Summary of Water Management Strategies from the 2016 Regional Water Plan No Longer Relevant or Actively Evaluated in the 2021 Regional Water Plan

At the request of the Coastal Bend Regional Water Planning Group, this chapter summarizes strategies previously evaluated in the 2016 Regional Water Plan to retain this knowledge and for efficiency should these strategies become applicable during future planning cycles. Chapter 11.4 summarizes strategies evaluated in plans prior to the 2016 Plan. Since these strategies are no longer being considered, costs were not updated to current 2021 Plan indices.

11.3.1 Manufacturing Water Conservation and Nueces River Water Quality Issues (previous 5D.3, Considered WMS)

Previous Water Quality Analyses

For the 2001 Regional Water Plan, a surface water and groundwater evaluation was conducted for the Nueces River downstream of Lake Corpus Christi. The study showed the most significant concentration increase in chlorides (and dissolved minerals in general) occurs with increasing depth within the channel. Another phase of this evaluation aimed to identify the possible sources of elevated levels of dissolved solids in the Nueces River water. The results of the surface water and groundwater interaction study are included in the 2001 Plan.

The Nueces River Partnership developed a watershed protection plan for the Lower Nueces River for the 182.6 square miles contributing to the Nueces between Lake Corpus Christi and the saltwater barrier dam. The Texas Clean Rivers Program developed a watershed management approach to conducting basin wide water quality assessments required by Senate Bill 818. Water quality data from this effort is available for Lake Corpus Christi and the 39 river miles downstream to the saltwater barrier. The Nueces BBASC Study #3, conducted by HDR, describes nutrient budgets based on quantitative understanding of natural supply of all nutrient forms and anthropogenic changes in these supplies over time for the Nueces Bay watershed and determines annual loads for pre-development and current conditions.

Assessment of Water Budget and Salinity in the Lower Nueces River Basin

The major purpose of this assessment included in the 2016 Plan is to improve understanding of: 1) surface water/groundwater interactions; and 2) influences on water quality conditions. The areas of interest are Lake Corpus Christi (LCC) and the Nueces River between LCC and Calallen. A map of the study area and stream gaging stations is shown in Figure 11.2. Data used for the study included streamflow, groundwater levels, groundwater quality, stream water quality, precipitation, lake evaporation, LCC stage, volume, and direct lake diversions, and Calallen diversions.

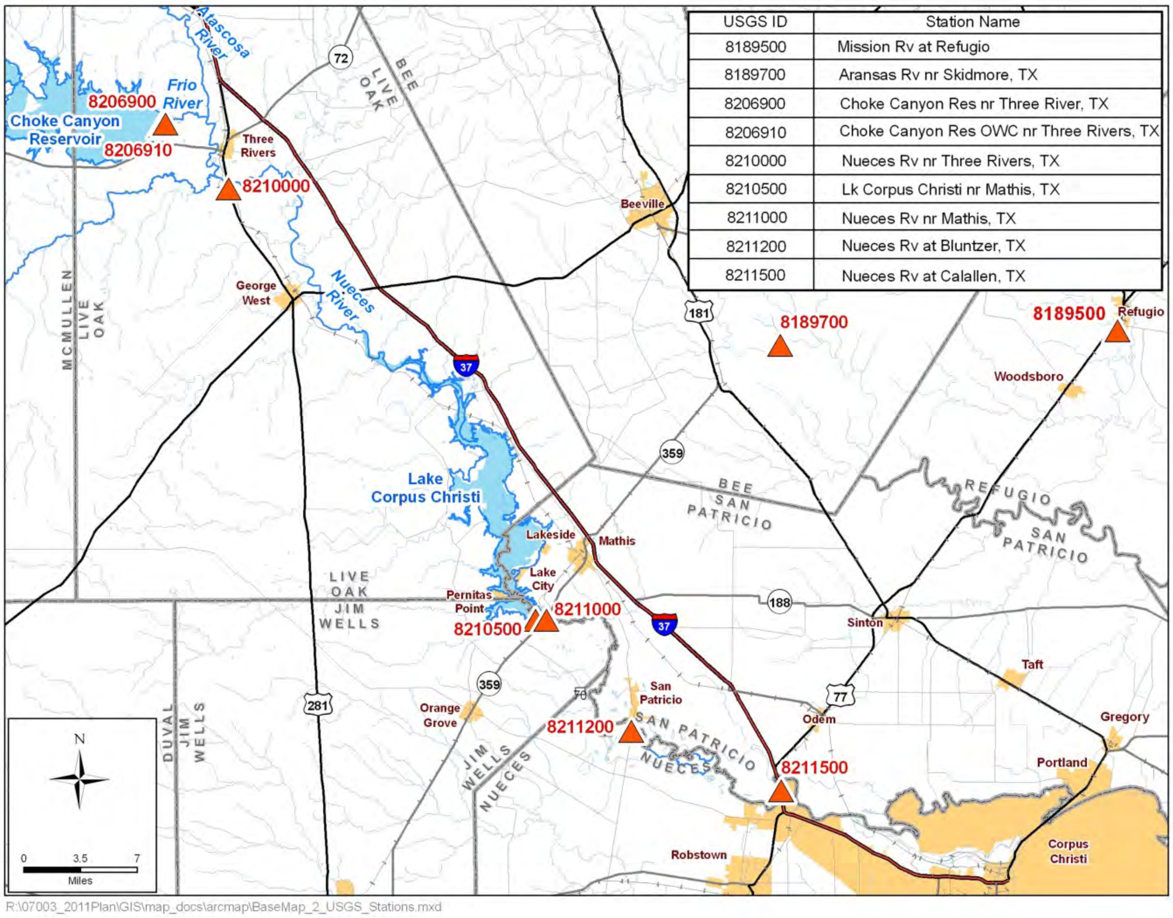

Figure 11.2.
Location of Study Area and Streamflow Gaging Stations

The interaction or movement of water between the Nueces River, LCC, and major aquifers is studied for the Nueces River reach between Mathis and Calallen (Figure 11.2). For LCC, the interaction is studied by calculating the seepage into and out of the lake from a water budget model. For the Lower Nueces River, the interaction is studied by calculating the streamflow gains and losses between streamflow USGS gaging stations.

A major use of the water from LCC and the Lower Nueces River is for municipal and industrial purposes. As a result, there is a great interest in not only having a sufficient supply during all times but to have water quality meet drinking water standards and be consistent over time. One of the long-term issues with water from the Calallen Pool is variable water quality, especially with regard to salinity (chloride concentrations) during the summer and periods of drought. For LCC, the hydrologic influences on water quality are studied with regard to the inflow from the Nueces River and surface water/groundwater interaction. Other potential significant influences are stratification of the lake, especially in the deep section near the dam, and evaporation. Increasing and decreasing salinity between streamflow gaging stations is studied for the Nueces River downstream of LCC.

11.3.2 Reclaimed Wastewater Supplies and Reuse (previous 5D.5, Recommended WMS)

Choke Canyon/Lake Corpus Christi Yield Recovery through Diversion of the City of Corpus Christi WWTP Effluent and/or Freshwater River Diversions through the Rincon Pipeline to the Nueces Delta

The TCEQ 1992 Interim Order established operational procedures for the CCR/LCC System that included a monthly schedule of desired inflows to Nueces Bay to be comprised of releases, spills, and return flows. The Order also directed studies such as the feasibility of relocating wastewater discharges to locations where increased biological productivity could justify an inflow credit computed by multiplying the amount of discharge by a number greater than one. Prior to reopening the Rincon Bayou Demonstration Project in 2001, the Nueces River bypassed the Nueces Delta and flowed directly into Nueces Bay except during periods of high flow. Previous studies have shown that diversions of both river water and treated wastewater to the Nueces Delta can be expected to increase primary production by factors of about three to five when compared to allowing these waters to enter Nueces Bay via the Nueces River.

Previous studies indicate that the Nueces Delta and Nueces Bay are critically important as the site of much of the planktonic primary production that drives biological processes throughout the Nueces Estuary. There is evidence that treated wastewater could have as much as a five-fold stimulatory effect on primary productivity if discharged into the Nueces Delta rather than being discharged into the Nueces River. Therefore, it is recommended that wastewater be diverted and discharged into the Nueces Delta to help meet the freshwater inflow requirement, as specified in the 2001 Agreed Order, under which the CCR/LCC System now operates.

This strategy considered in the 2016 plan examines potential yield recovery assuming 2 mgd of wastewater from Allison WWTP and up to 32 mgd of river water from the Calallen Pool through the Rincon Pipeline that could be discharged into the Nueces Estuary. Without biological productivity multipliers, 2 mgd of wastewater would be expected to yield 250 ac-ft/yr. A series of model runs were performed using the updated Corpus Christi Water Supply Model to determine and quantify water supply benefits associated with different quantities of water being delivered to the Nueces Estuary for a range of biological multipliers.

Model simulation results indicate that yield increase ranges from just under 1,000 ac-ft for diverting 2 mgd of treated wastewater to the Nueces Estuary with a multiplier of 2 to over 17,000 ac-ft with a river diversion of 32 mgd and a multiplier of 5. A 2 mgd treated effluent diversion project with a multiplier of 5 is roughly equivalent in terms of increased yield to a combination project of 13 mgd diverted to the Nueces Estuary (11 mgd of river water and 2 mgd of treated effluent) with a multiplier of 2. The 32 mgd scenarios produce the highest yield increases compared to the other scenarios. By changing a biological multiplier of 2 to 5, at least for the volumes evaluated herein, an increase of about 2.4 to 2.5 times in firm yield would be expected.

Much of the infrastructure is already in place for this water management strategy. The Rincon Pipeline was built by the City of Corpus Christi and became operational in November 2007. The Allison WWTP owned and operated by the City of Corpus Christi also has some infrastructure still in place from the Allison demonstration project. These facilities can deliver about 2 mgd from the plant. The estimated operating costs to deliver 2 mgd from the Allison WWTP are approximately $84,000 per year. This annual costs produces a unit cost ranging from $90.23 per ac-ft for a multiplier of 2 down to $17.25 per ac-ft for a multiplier of 5. The estimated annual operating costs for the Rincon Pipeline are $150,000 for delivering 11 mgd, which results in unit costs ranging from $109.07 per ac-ft for a multiplier of 2 down to $45.08 per ac-ft for a multiplier of 5. If the options were combined with both the 11 mgd of river water and 2 mgd of effluent the annual operating costs are estimated to be $548,000. This annual costs produces a unit cost ranging from $116.35 per ac-ft for a multiplier of 2 down to $45.85 per ac-ft for a multiplier of 5.

Wastewater Reuse Considerations for Municipal and Industrial Purposes

In general, primary industrial customers utilize similar facility processes that are mainly responsible for water consumption, such as cooling towers and boilers. In addition, industry also uses freshwater for drinking water, sanitary use, equipment wash-down, and fire protection. The primary differences in water usage, however, are product related. Process requirements influence the size and type of cooling systems and boilers needed for steam production. Process and product differences affect water quantity and quality needs. Depending on the industrial facility's plant size, age, and market conditions, different plants in the same industry category can have different water needs and water use efficiencies.

The following factors influence and control current water use, the potential for industrial water conservation, and the potential for area industries to use alternative sources of water, including treated municipal wastewater, brackish groundwater, and seawater. The list of important factors includes:

- The location of each water-using industrial plant in relation to a source or sources of water;
- The location of each water-using industrial plant in relation to streams or other features into which wastewater can be discharged;
- The type of industry, which determines the type of water use (i.e. refineries which use varying and/or different grades of crude petroleum, refineries which are producing reformulated gas, chemical plants which produce a range of chemicals and pharmaceuticals, and plants which extract compounds from ores to produce metals and other products); and
- The metallurgy of equipment in the cooling system that would come in contact with the cooling water.

Analyses and Discussion of Consumptive Wastewater Reuse and Advanced Conservation as Related to Estuaries Inflow Requirements

Without implementation of water conservation measures wastewater discharges are projected to increase at a rate of about 900 ac-ft per year. If selected accelerated conservation measures are implemented, then wastewater flows could be expected to reduce, depending on the type of conservation measures. Therefore, the benefit of increased water supply associated with advanced conservation must be weighed against the resultant reductions in the steady discharge of treated effluent containing nutrients to primary productivity in the Nueces Estuary.

11.3.3 Modify Existing Reservoir Operating Policy and Safe Yield Analyses (previous 5D.6- Recommended WMS)

The City of Corpus Christi operates the Calallen Pool, Lake Corpus Christi, Choke Canyon Reservoir, MRP Phase I (Lake Texana), and MRP Phase II as a system to supply water for municipal and industrial users of the Coastal Bend Region. Using the Corpus Christi water supply model, this water management strategy examines modifying the current reservoir operating policy from firm yield to safe yield. The maximum yields available under the City's current reservoir operating policies and existing schedule governing freshwater pass-throughs to the bay and estuary in 2020 and 2070 are 259,000 and 249,000 ac-ft/yr. With safe yield supplies, the yield of the system is reduced by 40,000 ac-ft/yr in 2020 and 35,000 ac-ft/yr in 2070, based on sedimentation conditions, to 219,000 and 214,000 ac-ft/yr.

The modification of existing reservoir operating policy strategy from firm to safe yield reduces the planned supply (yield) from the LCC/CCR/Lake Texana/MRP Phase II system to account for unprecedented severe drought conditions in the future or underestimation in regional growth. The additional stored water in LCC/CCR under safe yield provisions results in higher system storage levels and therefore more frequent opportunities for larger pass-through events to the Nueces Bay to meet inflow targets of the 2001 TCEQ Agreed Order. With safe yield, the median monthly flow to the Bay is 2,171 ac-ft/mo compared to 1,625 ac-ft/mo under firm yield conditions (increase of 546 ac-ft/mo). A flow frequency showing monthly Bay inflow comparing firm and safe yield is shown in Figure 11.3. An evaluation summary of this regional water management strategy is provided in Table 11.4.

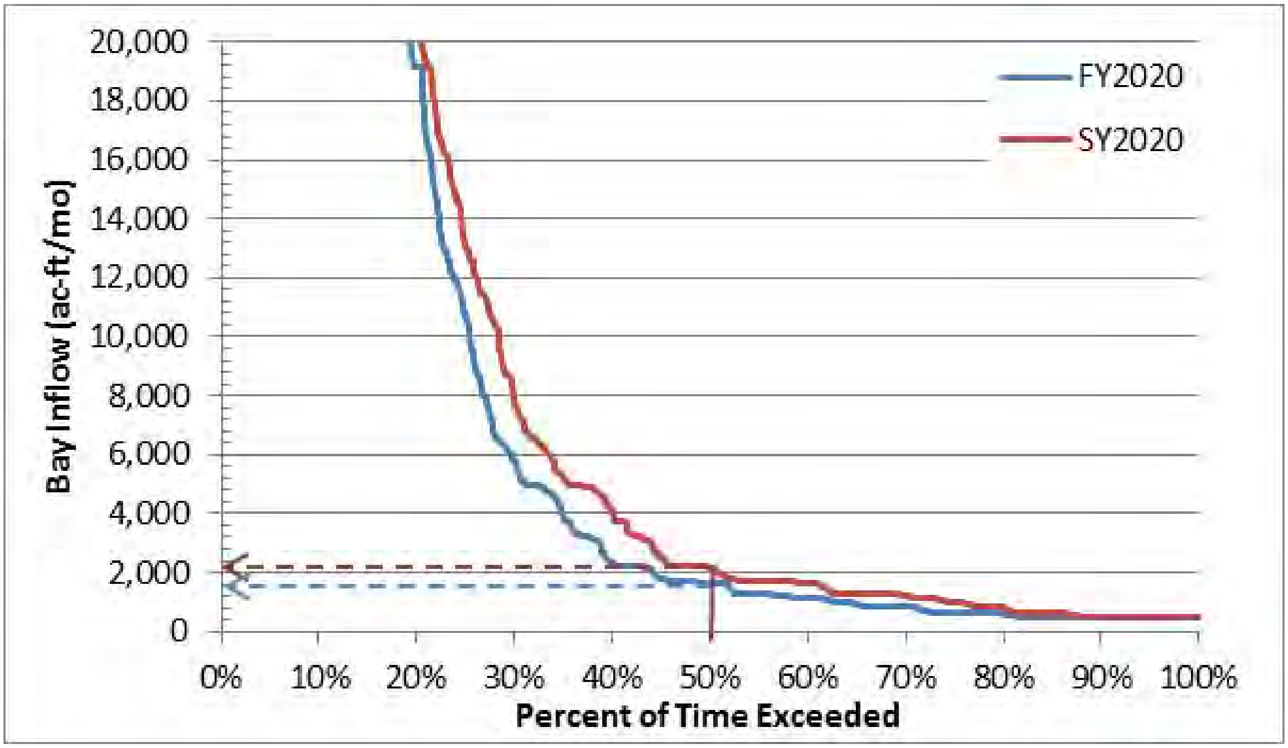

Figure 11.3.
Comparison of Monthly Flow Frequency Distribution for Nueces Bay Inflow for Firm Versus Safe Yield

Table 11.4.
Evaluation Summary for Modifications to Existing Reservoir Operating Policy

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. No project yield. Safe yield supply is less than firm yield.
2. Reliability	2. Good reliability. Provides storage reserve of 125,000 ac-ft (equal to one year of demand). Drought management measure amid climate uncertainty.
3. Cost of treated water	3. No cost.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows	2. Potential increase to bay and estuary inflows with higher storage levels to maintain safe yield reserve.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. None or low impact.
6. Cultural resources	6. None or low impact.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. None or low impact.
c. State water resources	• No negative impacts on other water resources • Potential benefit to Nueces Estuary from increased fresh water flow.
d. Threats to agriculture and natural resources in region	• None
e. Recreational	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides enhanced recreational opportunities for the lakes.
j. Effect on navigation	• None

11.3.4 Blending Groundwater and Treated Surface Water Strategies (portion of Gulf Coast Aquifer Supplies 5D.7- considered WMS)

This strategy evaluated the potential for blending brackish groundwater with existing treated surface water supplies at three different well fields located in Aransas, San Patricio, and Nueces County, as shown in Figure 11.4. The Aransas and San Patricio County options would blend brackish groundwater with treated surface water from SPMWD, while the Nueces County option would blend groundwater with treated City of Corpus Christi surface water from the O.N.

Stevens WTP. A key consideration for this strategy is the quantity of brackish groundwater that can be blended with existing surface water supplies while maintaining water quality within acceptable limits and avoiding increased corrosion within the system. Water quality goals are established for the evaluated locations based on existing water quality compared to blended water quality and standard corrosion indices calculations.

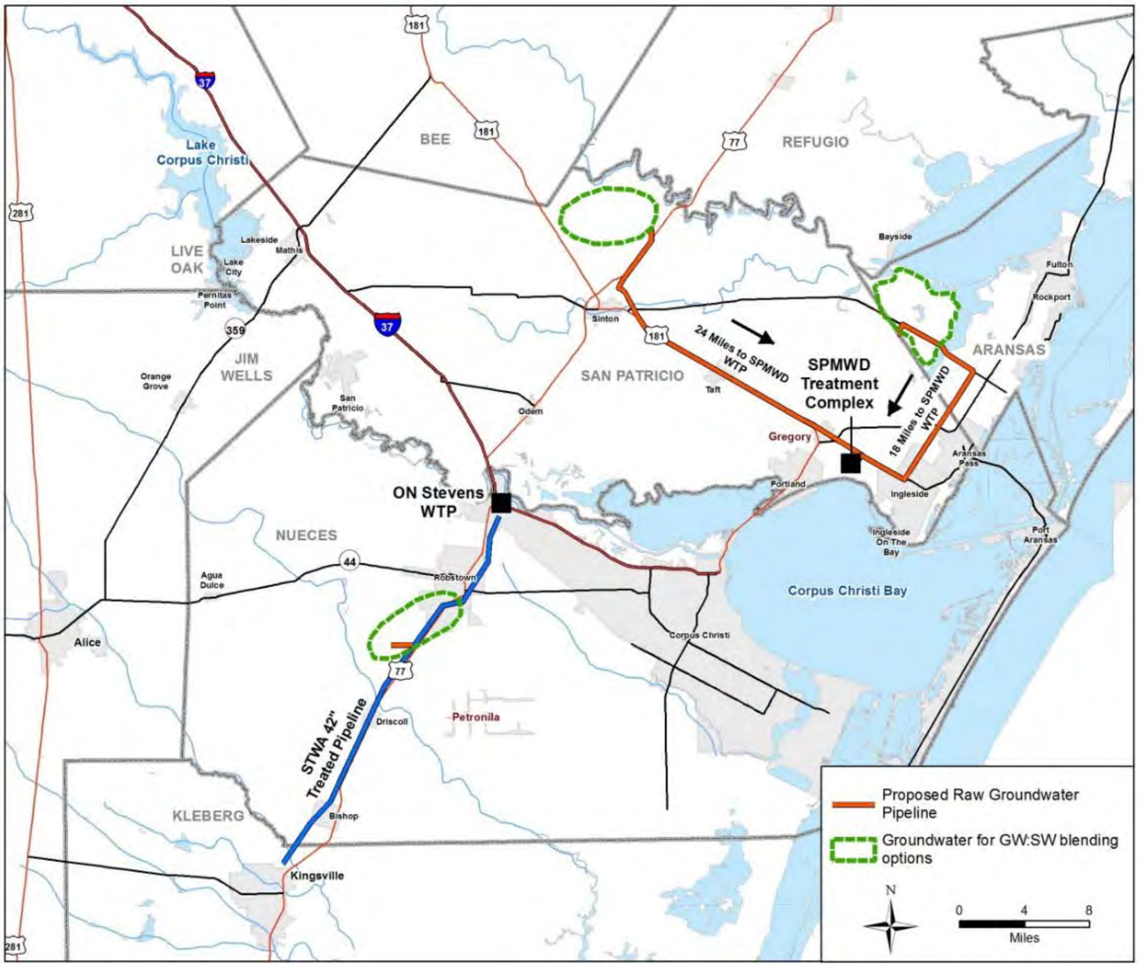

Figure 11.4.
Location of Brackish Groundwater Well Fields

For all three blending options, chloride is the limiting constituent. The target maximum chloride concentration for the Aransas and San Patricio County brackish groundwater blended with SPMWD is 210 mg/L based on industrial water quality targets. The Nueces County blend with City of Corpus Christi surface water from O.N. Stevens WTP has a target chloride maximum of 300 mg/L, the regulatory limit. At these target chloride concentrations the maximum percentage of each of groundwater that can be blended with surface is shown in Figure 11.5.

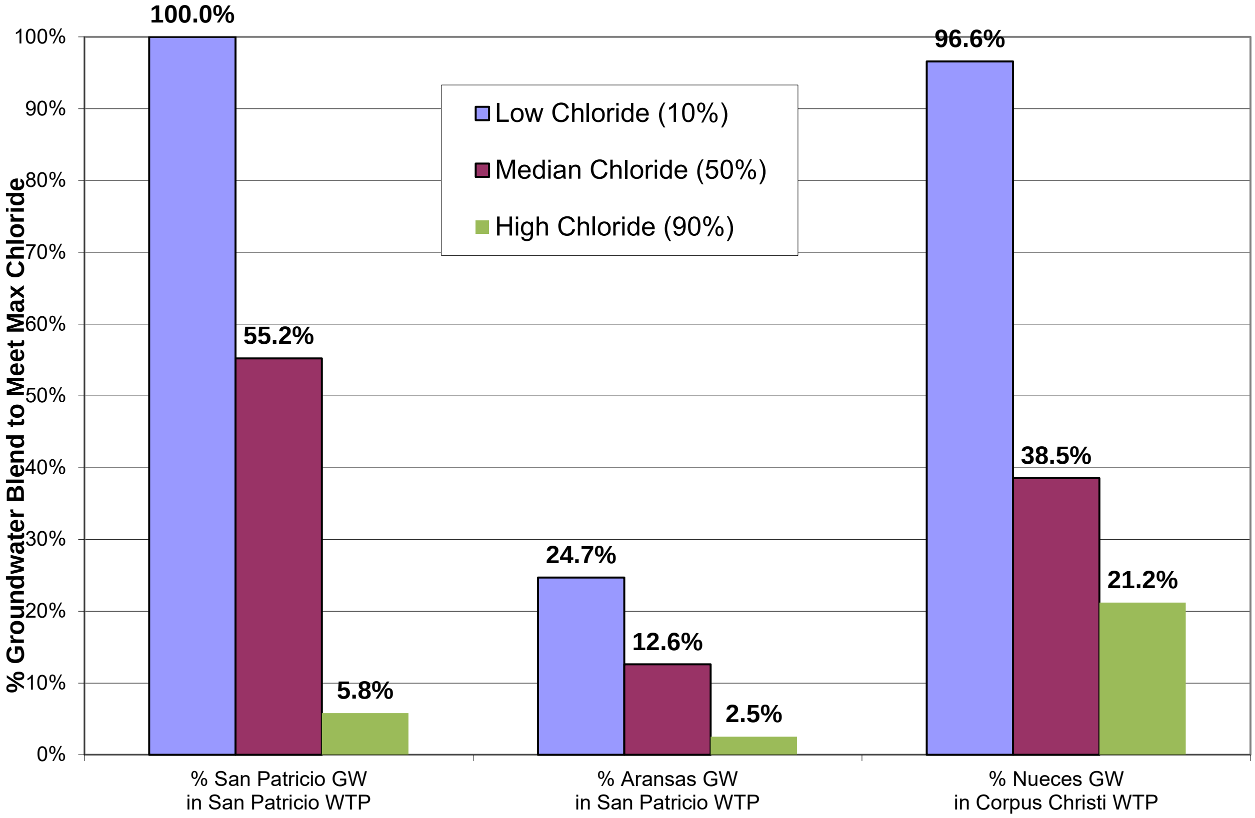

Figure 11.5.
Maximum Brackish Water Blend to Meet Chloride Limits

Cost estimates were performed for each study area considering high (90%) chloride concentrations. For the Aransas County well field, twelve wells are suggested with an assumed capacity of 75 gpm at a depth of 400 ft. Eighteen miles of twelve inch diameter transmission line is needed for blending at the SPMWD treatment complex. The total project cost for the Aransas option is estimated at $13,480,000 with an annual cost of $1,326,000. For an available project yield of 1,174 ac-ft/yr, the treated water will cost $1,129 per ac-ft and have a unit cost of $3.47 per 1,000 gallons. The Nueces County option considers three wells with a capacity of 200 gpm at a depth of 500 ft and 2 miles of 6 inch diameter transmission line. The total project cost is estimated at $4,630,000 with an annual cost of $514,000. The treated water will cost $727 per ac-ft and have a unit cost of $2.23 per 1,000 gallons.

The San Patricio option considers 8 wells with an assumed capacity of 250 gpm at a depth of 600 ft. Twenty-four miles of 14 inch diameter transmission line is needed for blending at the SPMWD treatment complex. The total project cost is estimated at $24,190,000 with an annual cost of $2,667,000. The addition of brackish groundwater to the existing treated water system will cost $902 per ac-ft and have a unit cost of $2.77 per 1,000 gallons. An additional cost estimate for San Patricio County was conducted considering median chloride concentrations and a blend consisting of 55.2% brackish groundwater – significantly increasing the project yield from 2,958 to 28,155 ac-ft/yr. This option considers 78 wells with an assumed capacity of 250 gpm at a depth of 600 ft, and 24 miles of 36-inch diameter transmission line. The total project cost is estimated at $110,706,000 with an annual cost of $14,772,000. The treated water will cost $525 per ac-ft and have a unit cost of $1.61 per 1,000 gallons.

Table 11.5 provides a summary of blending groundwater and treated surface water strategies within the Gulf Coast Aquifer.

Table 11.5. Evaluation Summary for Blending Groundwater and Treated Surface Water

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 707 to 28,155 ac-ft/yr.
2. Reliability	2. Water Quality: Fair.
3. Cost of treated water	3. Cost: $525 to $1,129 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local pumping and groundwater-surface water interaction.
2. Bay and estuary inflows	2. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
3. Wildlife habitat	3. Negligible impacts.
4. Wetlands	4. Negligible impacts.
5. Threatened and endangered species	5. Negligible impacts.
6. Cultural resources	6. Cultural resources will need to be surveyed and avoided.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Negligible impacts. a. Low to moderate impact. b. Low to moderate impact. c. No impact. d. Low to moderate impact. e. Low to moderate impact. f. Low to moderate impact. g-h. Low to moderate impact associated with mining. i. Boron may be a potential water quality concern.
c. Impacts to State water resources	• No negative impacts on water resources other than lowering Gulf Coast Aquifer; Potential benefit to Nueces Estuary from increased freshwater return flows attributed to increased supplies and demands.
d. Threats to agriculture and natural resources in region	• May slightly increase pumping costs for agricultural users in the area due to localized drawdowns
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable to groundwater sources
h. Third party social and economic impacts from voluntary redistribution of water	• May require the purchase of groundwater rights
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities with local resources
j. Effect on navigation	• None

11.3.5 Regional Well-Field Systems (portion of Brackish Groundwater Desalination 5D.8- Alternative WMS)

Brackish groundwater supplies have been desalinated to potable standards in areas near Region N and are likely to become more prevalent under the compounding pressures of increasing water demands and climate uncertainty. The Regional Well Field Systems strategy, included in the 2016 Plan, provides an evaluation of three independent well fields, as shown in Figure 11.6, for brackish groundwater supplies from the Gulf Coast aquifer, and includes treatment and delivery to one or more Region N utilities. A key consideration in developing this strategy is groundwater availability. Groundwater availability models (GAM) used to administer permits and manage groundwater resources do not currently delineate between fresh and slightly brackish water. Therefore, brackish water is often included in modeled available groundwater (MAG) estimates, which limits groundwater availability for regional water planning purposes. For any of the three independent well fields to be developed, the MAGs and DFCs from the 2016 Plan will need to be increased by the withdrawal amount.

The Bee-San Patricio well field option considers two alternatives for delivery of treated water to the O.N. Stevens WTP and to SPMWD's water main near U.S. Hwy 77 located about two miles south of Sinton. There are two options for disposal of concentrate, deep-well injection and discharge to Copano Bay. The project is designed to yield 21.4 mgd (24,000 ac-ft/yr) and provide a treated water supply with a total dissolved solids concentration of about 400 mg/L. Estimated total annual costs for these options range from $20,470,000 to $22,424,000, or $853 to $934 per ac-ft.

The Nueces Northwest well field project is designed to deliver treated water to the O.N. Stevens WTP. Concentrate would be disposed into deep-injection wells. The project design is to yield 16.1 mgd (18,000 ac-ft/yr) and provide a treated water supply with a TDS of about 400 mg/L. The total annual cost of project is estimated at $18,566,000 or $1,031 per ac-ft.

The Nueces South-Central project is designed with two options. One is to deliver treated water to the City of Corpus Christi's distribution system near the intersection of TX Hwys 286 and 2444 and to dispose the concentrate to Oso Bay through the Barney Davis Power Station. The other option is to deliver treated water to the STWA pipeline near Bishop and dispose of the concentrate to deep-injection wells. This strategy is to make water available for STWA customers and to supplement the supplies at the O.N. Stevens WTP. The projects are designed to yield 10.7 mgd (12,000 ac-ft/yr) at a uniform rate. The project is to provide a treated water supply with TDS of about 400 mg/L. The estimated annual cost to deliver treated water to the City and concentrate to Oso Bay is $13,590,000, or $1,133 per ac-ft. The annual cost to deliver treated water to STWA and concentrate to deep-injection wells is $15,028,000 or $1,252 per ac-ft.

A summary of all three well field options is included in Table 11.6, below.

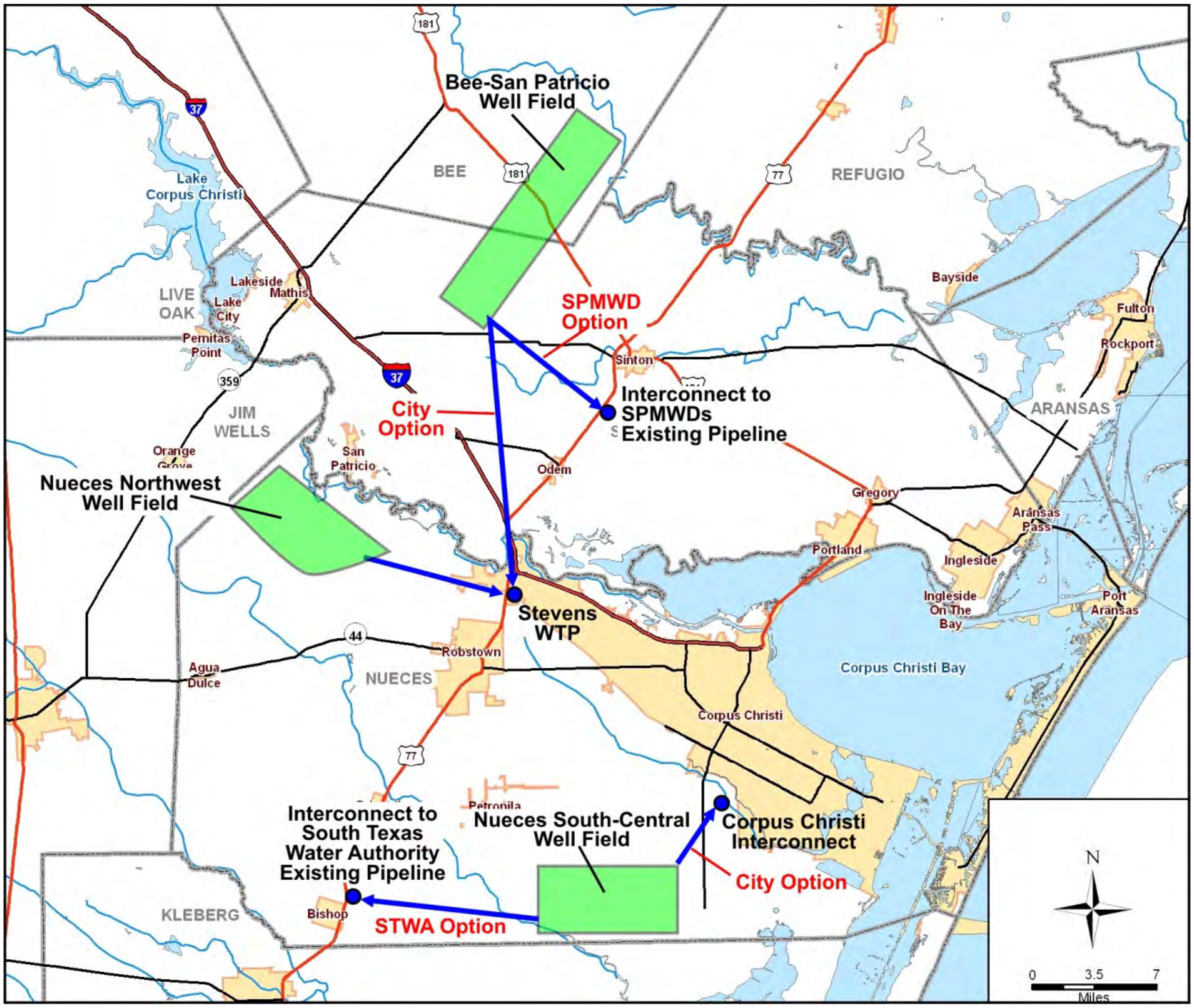

Figure 11.6.
Location of Brackish Groundwater Well Fields

Table 11.6.
Evaluation Summary for the Brackish Groundwater Desalination Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Variable, well field capacities ranges from up to about 24,000 ac-ft/yr.
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate to high cost; between $828 to $1,151/ac-ft for projects ranging from 12,000 to 24,000 ac-ft/yr.
b. Environmental factors:	
1. Instream flows	1. Moderate impact.
2. Bay and estuary inflows	2. None to low. However, greatest impact is during low-flow conditions.
3. Wildlife habitat	3. Disposal of concentrated brine with bay option may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be evaluated. 7d-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to State water resources	• Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Brackish groundwater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

11.3.6 Potential Water System Interconnections (Previous 5D.10-Recommended WMS)

In addition to providing backup water supplies for emergencies, water system interconnections were considered in the 2016 Plan as another potential source of freshwater supplies for municipal and industrial uses. Within the Nueces Region there are a number of municipal water systems that rely totally on local groundwater. Many of these groundwater systems operate under challenges inducing insufficient groundwater supply, insufficient well capacity, and unsuitable water quality. Therefore, connecting to the regional surface water system can make for a more reliable water supply. Community water system candidates considered in 2016 are located in Duval, Jim Wells, Brooks, Kleberg, and San Patricio Counties for interconnection within the Coastal Bend Region. Yields were determined by the maximum demands for each entity over the planning period and infrastructure constraints. For San Diego in Duval County, an additional analysis was run based on needs rather than the demand. Costs were calculated using the TWDB Unified Costing Model.

The interconnection strategies for Duval, Jim Wells, and Brooks counties were dependent on Alice's Water Treatment Plant which had a treated water capacity of 7,560 ac-ft/yr at the time of analysis. The City of Alice used 4,000 ac-ft of water in 2012 meaning that there are approximately 3,560 ac-ft/yr of water available for potential interconnect strategies. If all of the interconnection strategies that rely on Alice's Water Treatment Plant were to be implemented there would need to be an additional capacity of 2,486 ac-ft/yr.

All proposed water system interconnections are summarized in Table 11.7, and the overall strategy is summarized in Table 11.8.

Table 11.7.
Summary of Proposed Water System Interconnections (Sept 2013 prices)

County	Alt.	Pipeline From	Pipeline To	Pipeline Diameter (inches)	Pipeline Length (miles)	Additional Facilities	Yield (ac-ft/yr)	Total Cost of Project	Annual Cost of Water ($ per 1,000 gall)
Duval	1	Alice	San Diego, Benavides, Realitos, Concepcion, and Freer	6,10,18	83	5 Pump Stations	2,708	$34,786,000	$6.43
	2	Alice	San Diego, Benavides, and Freer	6,10,16	52	3 Pump Stations	2,098	$22,515,000	$5.82
	3	Alice	San Diego and Benavides	6,12	28	1 Pump Station	1,344	$10,542,000	$4.92
	4*	Alice	San Diego and Freer	10,14	36	2 Pump Stations	1,826	$18,035,000	$5.57
	5A	Alice	San Diego All Demands	14	11	-	1,072	$5,177,000	$3.99
	5B	Alice	San Diego Needs Only	6	11	-	158	$3,154,000	$8.35
Jim Wells	1	Alice	Orange Grove	8	17	1 Pump Station	494	$6,815,000	$6.86
	2	Alice	Premont	10	24	1 Pump Station	929	$9,398,000	$5.54
Brooks	1	Premont	Falfurrias	14	9	-	2,844	$21,117,000	$4.68
San Patricio	1	SPMWD Transmission Main	Sinton	12	8	-	1,507	$3,042,791	$3.32
	2	SPMWD Transmission Main	Edroy	6	6	-	125	$1,833,000	$6.36
	3	Six New Groundwater Wells	Mathis	6	6	6 Groundwater Wells	700	$5,545,000	$4.58
Kleberg/ Brooks/ Jim Wells	1	Kingsville	Riviera, Falfurrias, and Premont	10, 18	48	1 Pump Station	3,024	$34,899,000	$6.26
Nueces/ Jim Wells	-	STWA Pipeline at Agua Dulce	Alice	12	11.4	Storage Tank and 1 Pump Station	2,800	$5,866,000	$3.55

*September 2008 Prices

Table 11.8. Evaluation Summary of the Potential Water System Interconnections

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm yield: Range from 2,800 ac-ft/yr to 125 ac-ft/yr, depending on interconnection project.
2. Reliability	2. Good reliability.
3. Cost of treated water	3. Generally high project cost; between $2,722 to $336 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Possible low impact.
2. Bay and estuary inflows	2. Possible low impact.
3. Wildlife habitat	3. Construction and maintenance of transmission pipeline corridor(s) may impact wildlife species.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. Endangered species survey will be needed to avoid significant sites.
6. Cultural resources	6. Cultural resource survey will be needed to avoid significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. May potentially enhance water quality for rural communities. 7d. May improve water quality issues associated with chlorides for Sinton. 7f. May improve water quality issues associated with high hydrogen sulfide for Edroy.
c. Impacts to State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline(s)
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None

11.3.7 Lavaca Off-Channel Reservoir Project (previous 5D.12-Recommended WMS)

The Lavaca-Navidad River Authority (LNRA) has considered multiple scenarios for construction of new reservoir storage, including both on- and off-channel reservoirs. The Lavaca River Water Supply Project Feasibility Study, completed in 2011 by Freese & Nichols, Inc., compared a variety of these configuration options, as shown in Figure 11.7 below, and recommended the most feasible scenarios for implementation including either the West Off-Channel Reservoir Project or the East Off-Channel Reservoir Project Alternative B.

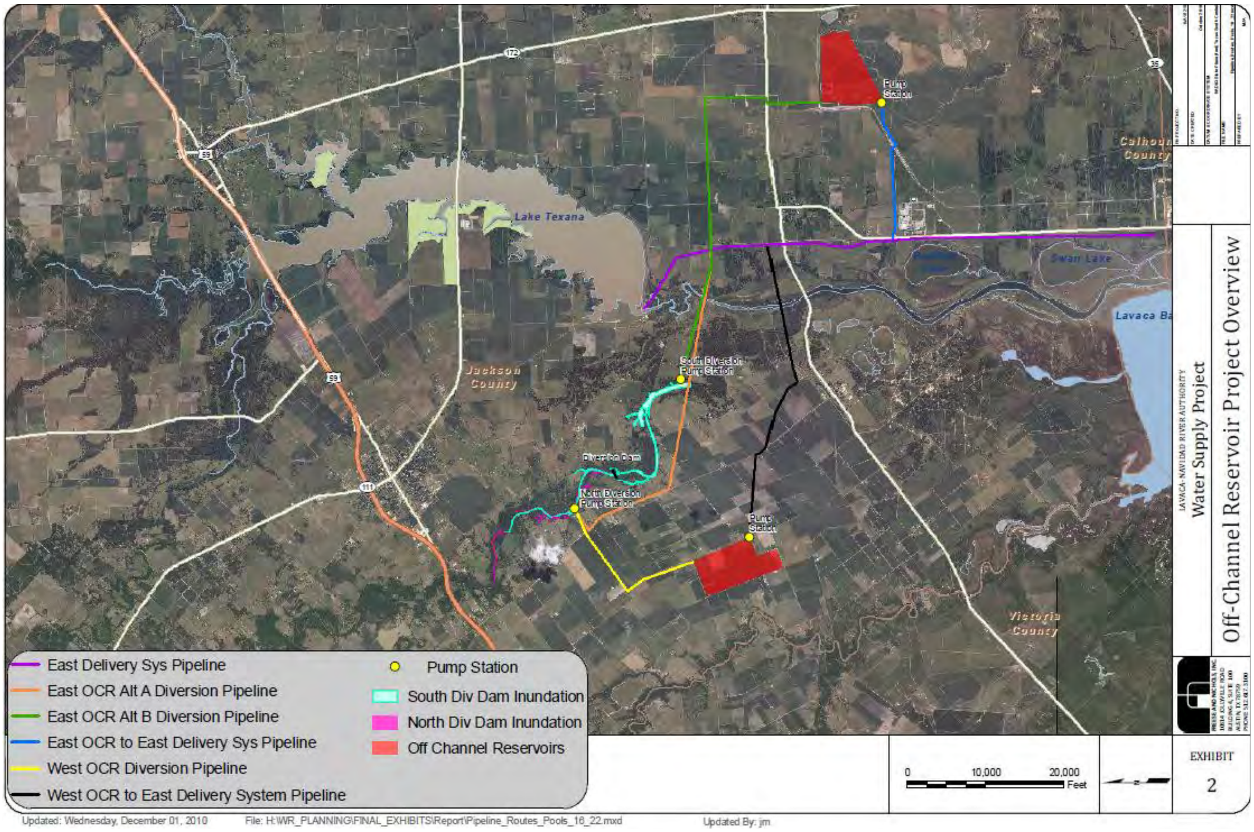

Figure 11.7.
Lavaca Off-Channel Reservoir Project Location

In both cases of the West Off-Channel and East Off-Channel B Reservoirs, the minimum facility requirements would include the storage reservoir and associated pump stations to deliver water from the river to the reservoir. Diversion points and conceptual level pipeline alignments are different in each scenario and shown in Figure 11.7 above. Two pump stations are required for both off-channel alternatives, including a Lavaca River diversion pump station to divert flows and an off-channel reservoir pump station to deliver raw water to the existing LNRA East Delivery System pipeline. A diversion dam to increase the in channel storage and optimize pumping opportunities is also considered in the scenarios in order to increase firm yield. A relatively small amount of in-channel storage could increase the project yield at minimal cost compared to the cost of increasing the size of the off-channel reservoir to store more water.

The total project cost of the Lavaca off-channel reservoir was estimated at $177,485,000 for a yield of 16,963 ac-ft/yr. When considering annual program costs, the unit cost would be approximately $867 per ac-ft for raw water and $1,236 per ac-ft assuming treated water cost of $369 per ac-ft. Costs assumed the more expensive East Off-Channel Alternative B, which is within approximately 10% of the cost of the West Off-Channel scenario. The costs do not include water treatment or raw water purchase. A summary of the Lavaca off-channel reservoir option is described in Table 11.9, below.

Table 11.9.
Evaluation Summary for Lavaca Off-Channel Reservoir Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm yield: 16,963 ac-ft
2. Reliability	2. Good reliability.
3. Cost of treated water	3. Moderate cost; $1,236 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Generally decreases instream flow below diversion.
2. Bay and estuary inflows	2. General reduction in bay and estuary inflows.
3. Wildlife habitat	3. Construction and maintenance of off-channel reservoir site and transmission pipeline corridor(s) may impact wildlife species.
4. Wetlands	4. Low impact to wetlands.
5. Threatened and endangered species	5. Likely low impact to endangered species. Endangered species survey will be needed to avoid significant sites.
6. Cultural resources	6. Cultural resources survey will be needed to avoid significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Minimal impact to water quality.
c. Impacts to State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions
g. Inter-basin transfers	• May be required for use in Region N.
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Maximizes opportunities to capture water from a large drainage area during high/moderate inflow events after environmental instream flow requirements are satisfied. Less evaporative losses expected than traditional reservoir.
j. Effect on navigation	• None

11.3.8 GBRA Lower Basin Storage Project (previous 5D.13-Recommended WMS)

To firm up the run-of-river supplies of water available under the GBRA/Dow Water Rights, an off-channel reservoir (OCR) near the GBRA Main Canal and Dow Seadrift Operations facilities was considered in the 2016 Plan. The off-channel reservoir had a proposed water depth of about 25 feet and the capability of impounding approximately 12,500 ac-ft of water. The OCR site was located in the lower Guadalupe – San Antonio River basin in Region L in close proximity to Region N infrastructure, presenting an inter-regional opportunity. The City of Corpus Christi's Mary Rhodes Pipeline and Bloomington Pump Station is located 15 miles north of the previously proposed OCR and was considered for delivering raw water supplies from the project to O.N. Stevens or SPMWD WTP prior to distribution to water users. Figure 11.8 shows the conceptual project layout.

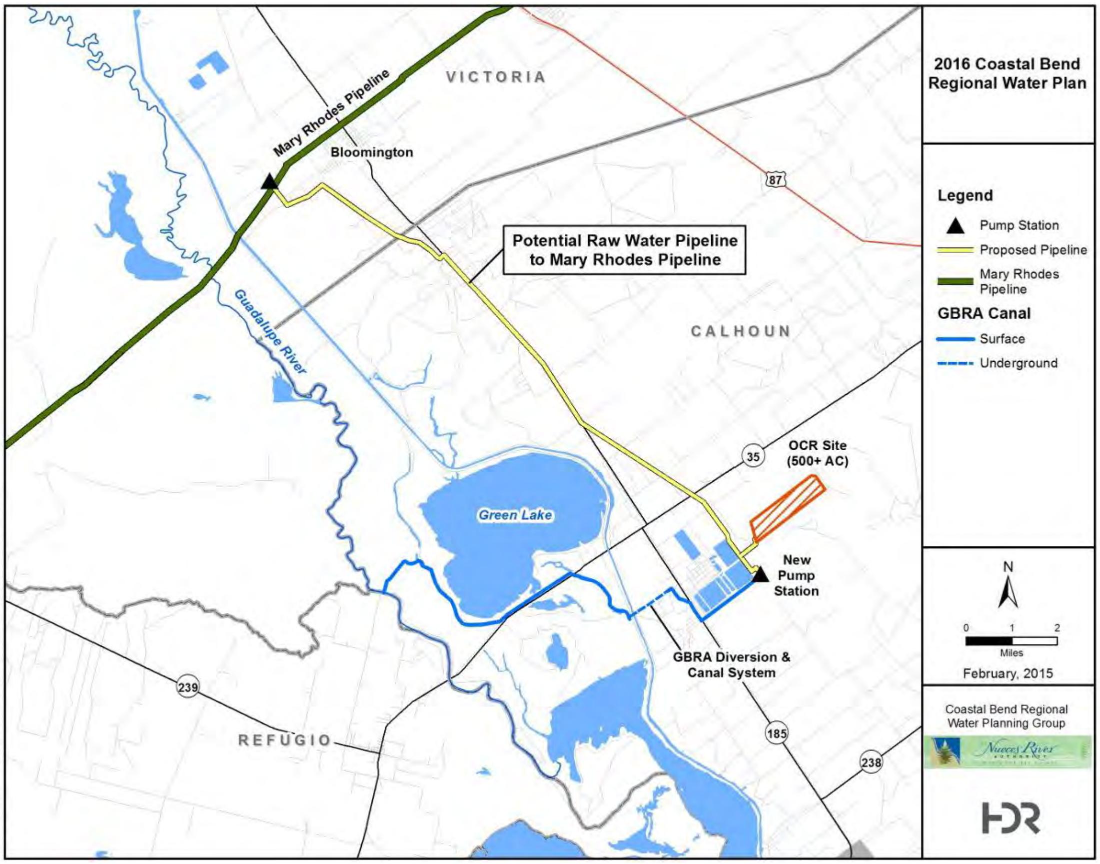

Figure 11.8.
Example Conceptual Route for Delivery of GBRA Lower Basin Stored Water to the Mary Rhodes Pipeline at Bloomington Pump Station

The total project and annual costs are $90,543,000 and $7,261,000, respectively, including debt service and operation and maintenance for the 12,500 ac-ft off-channel reservoir and associated facilities, such as the embankment and appurtenant facilities for the off-channel reservoir, a 50 cfs raw water intake and pump station, a 42-inch transmission pipeline, and a 72 inch outlet pipeline. For a firm yield of 51,800 ac-ft/yr (which assumes 100% direct reuse of all treated wastewater in both the Guadalupe and San Antonio River Basins), these annual costs translate to an annual unit cost of $140/ac-ft/yr for raw water at the GBRA Main Canal during the debt service period.

Region N's portion of total project and annual costs are $72,546,000 and $8,849,000, respectively, including debt service and operation and maintenance for participation in the 12,500 ac-ft off-channel reservoir and associated facilities on a prorata share basis. For a firm yield of 20,000 ac-ft/yr (38.6% of the 51,840 ac-ft project yield), these annual costs translate to an annual unit cost of $442 per ac-ft/yr for raw water at the Mary Rhodes Pipeline during the debt service period. This cost assumes that pending upgrades to the Mary Rhodes Pipeline to operate at full design capacity are complete at no cost to this water supply strategy. Assuming a treatment cost of $369 per ac-ft comparable to other Region N water management strategies, the annual unit cost of treated water is estimated to be $811 per ac-ft/yr. Table 11.10 provides a summary of the GBRA lower basin storage project.

Table 11.10.
Evaluation Summary of GBRA Lower Basin Storage Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield (Region N's portion): 20,000 ac-ft/yr. Firm Yield (total project): 51,800 ac-ft/yr.
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Moderate cost of $811 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Although source water is available under existing water rights, there may be some impact due to increased diversions from the Lower Guadalupe River. With Region N participation and project integration into the CCR/LCC/Texana/MRP Phase II system, increases in instream flows in the Nueces River may occur due to reduced water supply demands on the CCR/LCC system and consequently higher inflow pass-through targets according to 2001 Agreed Order provisions.
2. Bay and estuary inflows	2. Although source water is available under existing water rights, there may be some impact due to increased diversions from the Lower Guadalupe River, when available, for OCR storage needs to firm yield during droughts. With Region N participation and project integration into the CCR/LCC/Texana/MRP Phase II system, increases in instream flows in the Nueces River may occur due to reduced water supply demands on the CCR/LCC system and consequently higher inflow pass-through targets according to 2001 Agreed Order provisions.
3. Wildlife habitat	3. Some impact and wildlife habitat disturbance due to off-channel reservoir, intake, and transmission pipeline construction.
4. Wetlands	4. Low impact.
5. Threatened and endangered species	5. Several threatened and endangered species are listed in Calhoun County. It is not anticipated that this project will have any permanent adverse effect on any federally listed threatened or endangered species, its habitat, or designated habitat nor would it adversely affect any state listed species. Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project activities on threatened and endangered species as well as bald eagles.
6. Cultural resources	6. No cultural resources affected.

Impact Category	Comment(s)
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low impact. a,b,d. May possibly increase dissolved solids, salinity, and chlorides in the Lower Guadalupe River downstream of the GBRA Diversion System during periods when permitted run-of-the-river water is diverted to the OCR.
c. Impacts to State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• New authorization required for use outside of GBRA statutory district and within the San Antonio-Nueces Coastal Basin. More requirements must be met to obtain new authorization for uses in the Nueces River Basin or Nueces- Rio Grande Coastal Basin.
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• This project promotes efficient use of existing supplies and presents opportunities for regional supply development
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the pipeline construction on the environment

11.3.9 San Patricio Municipal Water District – Transmission and Industrial Water Treatment Plant Improvements (previous 5D.14- Recommended WMS)

In order to increase SPMWD system capacity to meet projected industrial water supply shortages, this water management strategy considered pump station and industrial water treatment plant improvements. For the purposes of this option, it was assumed that SPMWD and the City of Corpus Christi would develop recommended water management strategies to provide additional raw water supplies as needed.

At the time of analysis, the 36-inch line that ties into the Mary Rhodes Pipeline was able to deliver 28.5 mgd of raw water to the SPMWD WTP complex located southeast of Gregory. With pump station improvements, it will be capable of delivering 40.7 mgd. The 36-inch raw water pipeline from the Nueces River Calallen Pool intake was able to deliver 26.1 mgd to the WTP complex at the time of analysis. The 24-inch treated water pipeline from Corpus Christi delivered 5.5 mgd, which would increase to 10 mgd with a pump station. The total cost of facilities for these two pump stations was estimated at $9,400,000. Additionally, SPMWD Industrial WTP improvements are needed to increase average day treatment capacity by 18,529 ac-ft/yr, or 21.4 mgd, to meet industry needs. Estimated costs for WTP facilities are

$32,357,000. The total cost of project, excluding land costs as SPMWD already purchased land for pump stations, is an estimated $58,366,000. The total annual cost of system improvements is $14,997,000. Dividing annual cost by the project yield, and projected 2070 shortage of 18,529 ac-ft, equated to an annual cost of $809 per ac-ft or $2.48 per 1,000 gallons, as shown in Table 11.11.

Table 11.11.
Evaluation Summary for SPMWD Transmission and Industrial WTP Improvements

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. 18,529 ac-ft/yr.
2. Reliability	2. High reliability.
3. Cost of treated water	3. $809 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Negligible impact.
2. Bay and estuary inflows	2. Negligible impact. The SPMWD Transmission and Industrial WTP Improvements may have minor increases in return flows to Nueces Bay and Estuary.
3. Wildlife habitat	3. Negligible impact. The SPMWD Transmission and Industrial WTP Improvements will not disturb unaltered and/or new land.
4. Wetlands	4. Negligible impact.
5. Threatened and endangered species	5. Negligible impact. The SPMWD Transmission and Industrial WTP Improvements will not disturb unaltered and/or new land.
6. Cultural resources	6. Negligible impact. All work on SPMWD property or existing right-of-way should be no impact.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low or no impact. The SPMWD Transmission and Industrial WTP Improvements will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
c. Impacts to State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• None

11.4 Summary of Water Management Strategies from the 2011 Regional Water Plans or Prior No Longer Relevant or Actively Evaluated in the 2021 Regional Water Plan

11.4.1 Carrizo- Wilcox Aquifer Supplies (2011 Plan- considered WMS)

The City of Corpus Christi (City) owns a standby groundwater supply system of four wells located near the City of Campbellton in Atascosa County that are not currently in use (Figure 11.9). The option no longer being considered involves pumping water from the Campbellton well field and conveying it via pipeline to CCR, approximately 20 miles to the south. In order to bring the wells online, they will need to be inspected and redeveloped to maximize productivity. Well pumps will need to be purchased and installed, and a well field collection system of pipelines must be constructed to deliver the water to a terminal storage tank. From this storage tank, the water will be pumped via pipeline across the Atascosa River and over the Lipan Hills to CCR.

The proposed project was sized to convey 6 mgd of groundwater from the Campbellton well field to CCR. This is equivalent to approximately 1,000 gallons per minute from each of the four wells on a continual basis. Results of the cost estimate indicate that total capital costs for infrastructure associated with the project would be approximately $13,608,000. Annual costs would be on the order of $3,521,000. For the proposed project yield of 3,200 ac-ft/yr, this is equivalent to a unit cost of water of $1,100 per ac-ft. A summary of the Campbellton well strategy is provided in Table 11.12.

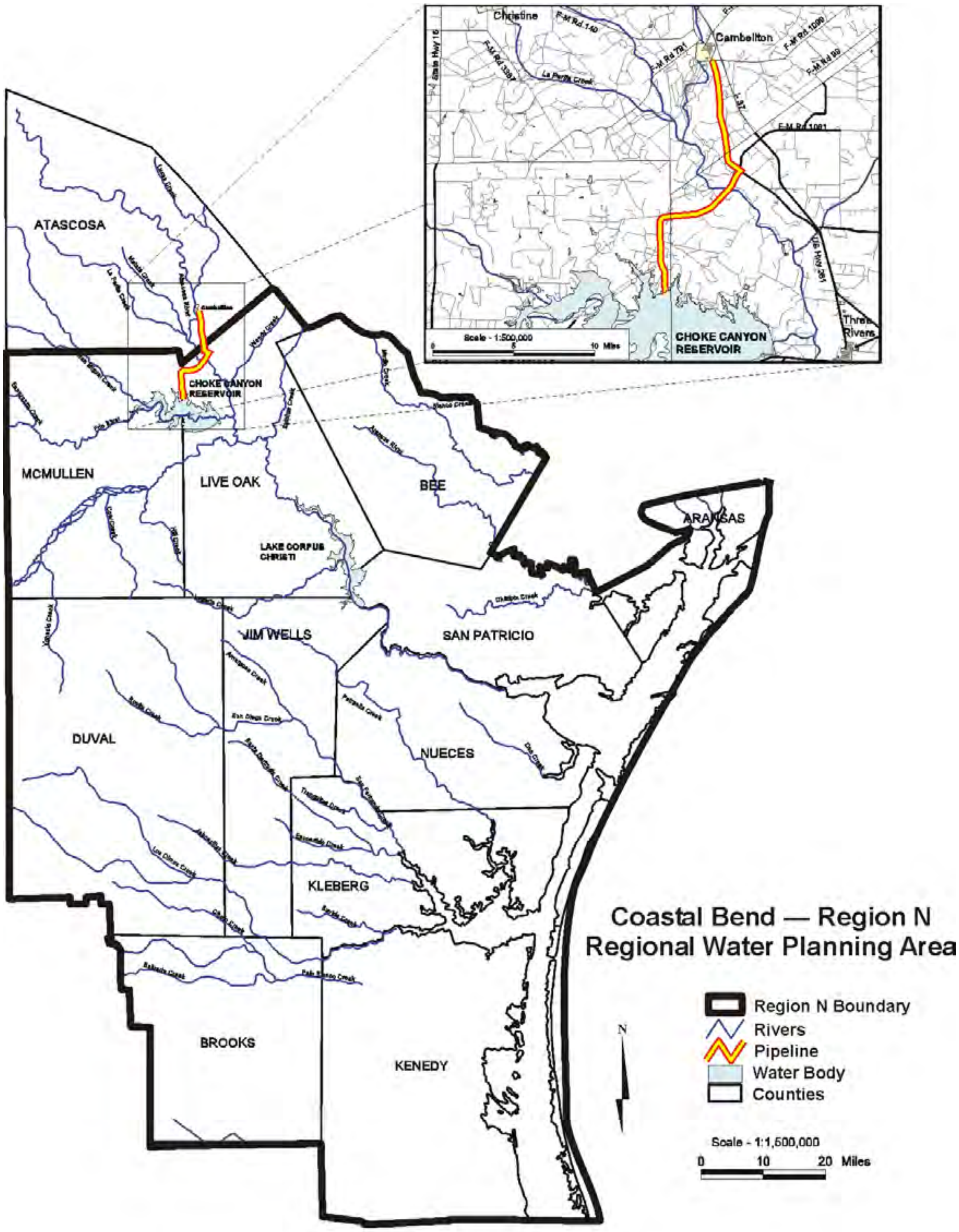

Figure 11.9.
Carrizo-Wilcox Supply Option

Table 11.12. Evaluation Summary of Campbellton Well Option to Enhance Water Supply Yield

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm yield: 3,200 ac-ft/yr.
2. Reliability	2. Good, assuming ability to pump 6,720 ac-ft/yr and recovery of 48 percent.
3. Cost of treated water	3. Cost: $1,100 per ac-ft/yr.
b. Environmental factors:	
1. Instream flows	1. Increase flows to CCR.
2. Bay and estuary inflows	2. Slight increase in bay and estuary inflows.
3. Wildlife habitat	3. Pipeline construction may temporarily disrupt local wildlife.
4. Wetlands	4. Minimal impact (pipeline crossing Atascosa River.).
5. Threatened and endangered species	5. Minimal impact along pipeline route.
6. Cultural resources	6. Cultural resources will need to be avoided when facilities are constructed.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. May have impacts to CCR due to mixing of groundwater with surface water supplies. b. Groundwater may be slightly saline. f. Groundwater may contain high sulfur content.
c. Impacts to State water resources	• Will result in lowering of groundwater levels in Campbellton area over time. No other apparent negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Cost model for option is based on literature values
g. Interbasin transfers	• Potential for interbasin transfer or exchange for other water with Region L
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Slight improvement over current conditions
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• Potential impacts to wildlife habitat

11.4.2 Gulf Coast Aquifer Supplies (2011 Plan- Recommended WMS)

The existing regional water system operated by the City of Corpus Christi (City) consists of — the CCR/LCC System in the Nueces Basin and Lake Texana in the Lavaca River Basin. One 2011 option considered conjunctive use of groundwater with the existing surface water supplies and evaluates the feasibility of securing groundwater supplies from the Gulf Coast Aquifer in Refugio County. For the conjunctive use of groundwater from the Gulf Coast Aquifer in Refugio County option, groundwater would be developed from two well fields along a southwest-northeast line about 3 miles west of the City of Refugio as shown in Figure 11.10. In addition, a brackish groundwater project in San Patricio and Bee Counties was evaluated to produce up to 24,000 ac-ft/yr. A smaller project was proposed to utilize fresh water supplies as may be available in Bee and San Patricio Counties for SPMWD and the City as shown in Figure 11.11.

Twenty-eight wells were assumed for the conjunctive use strategy. The annual costs, including power and the purchase of groundwater, are estimated to be $12,996,000 for 28,000 ac-ft of water. This option produces raw water delivered to the O.N. Stevens WTP at an estimated cost of $463 per ac-ft. If treatment of water is necessary, the treated water cost is $789 per ac-ft (assuming treatment costs of $326 per ac-ft) as shown in Table 11.13. Eleven wells were assumed for the future water supply projects in Bee and San Patricio Counties. The annual costs are estimated to be $9,494,000 for 18,000 ac-ft of water. This option produces raw water at an estimated cost of $527 per ac-ft. Assuming treatment costs of $326 per ac-ft, the treated water cost is $853 per ac-ft as shown in Table 11.14.

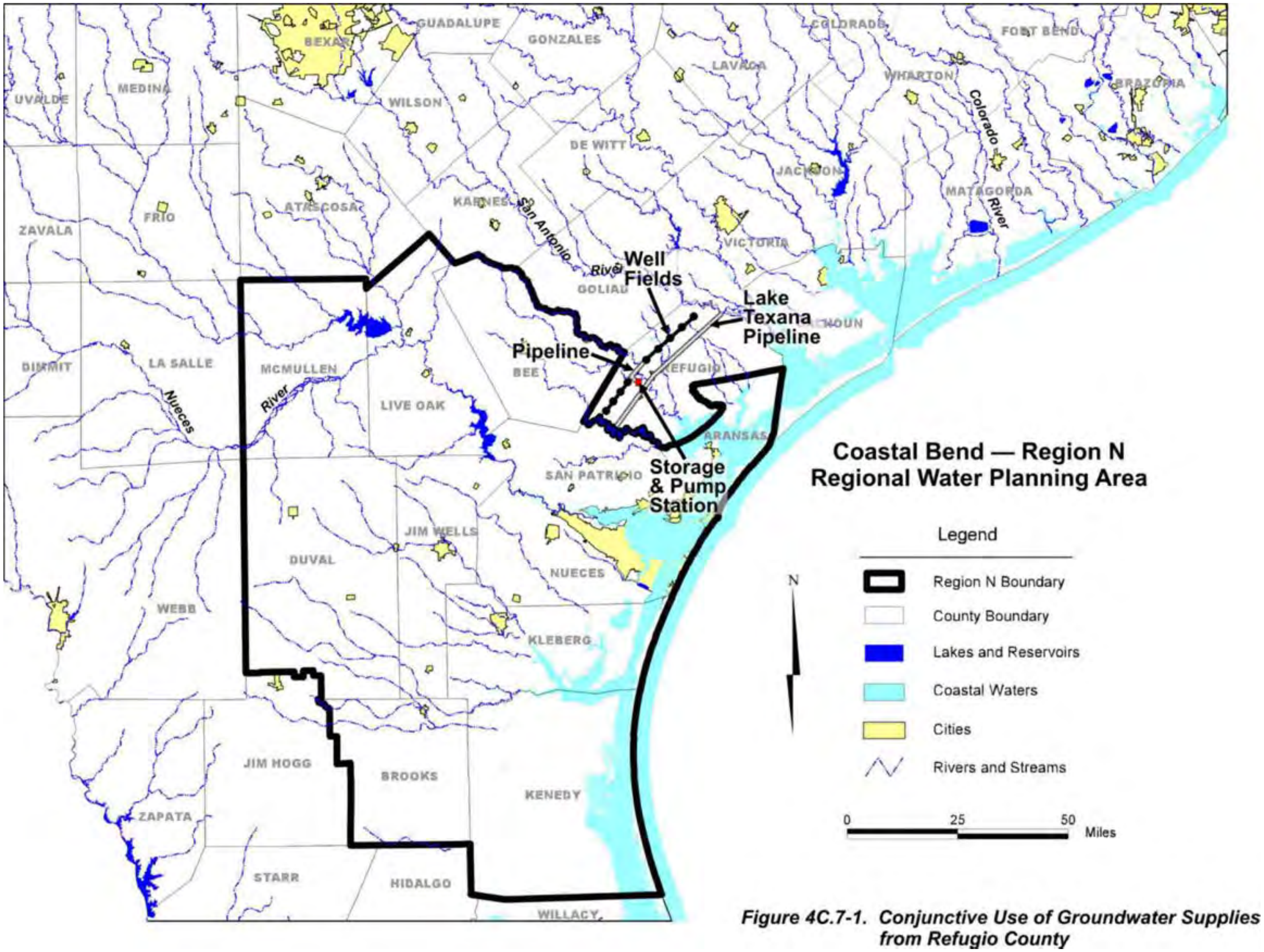

Figure 4C.7-1. Conjunctive Use of Groundwater Supplies from Refugio County

Figure 11.10.
Conjunctive Use of Groundwater Supplies from Refugio County

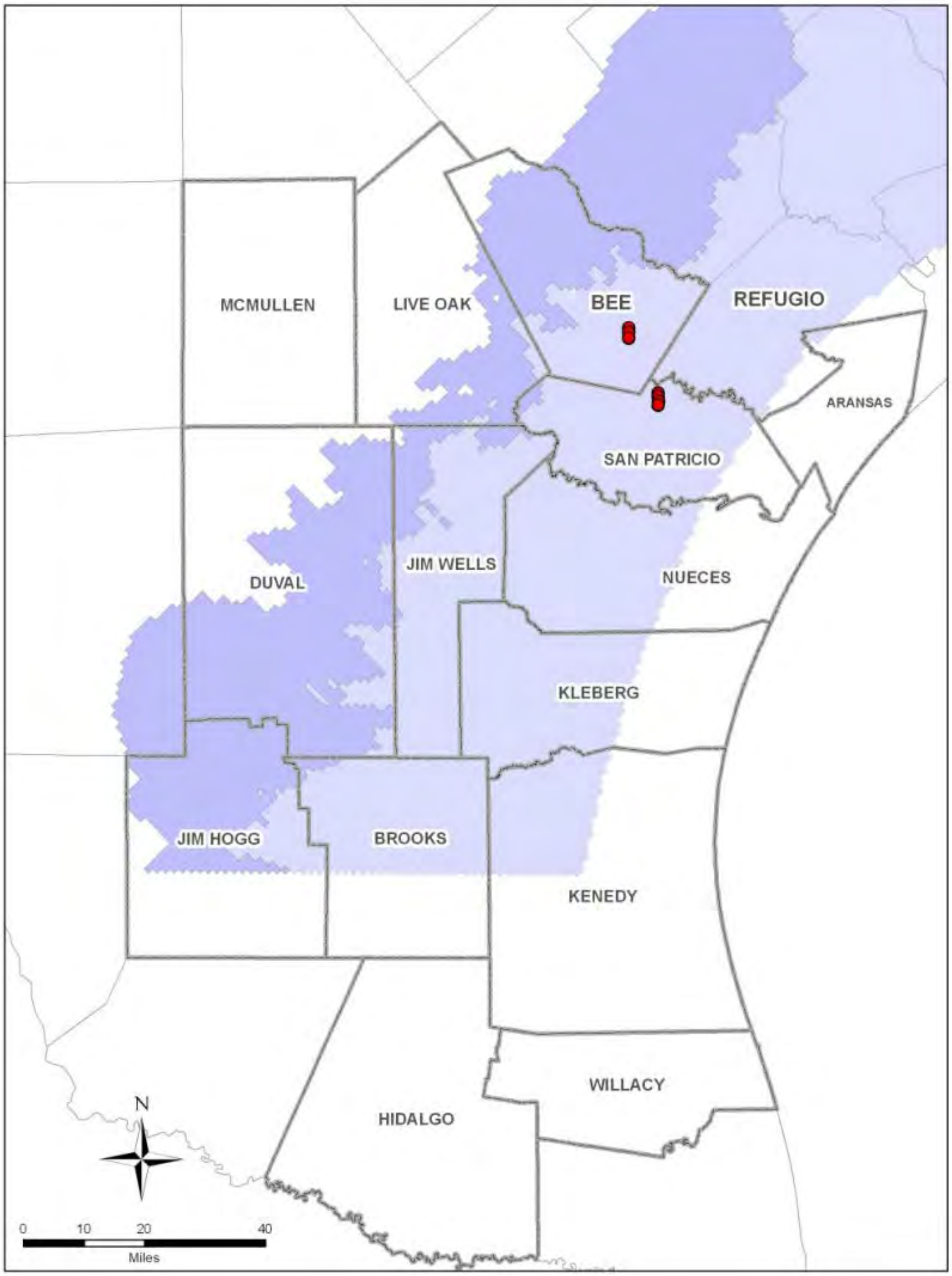

Figure 11.11.
Project Locations in the Evangeline Aquifer

Table 11.13. Evaluation Summary of the Refugio County Groundwater

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 28,000 ac-ft/yr.
2. Reliability	2. Water Quality: Fair.
3. Cost of treated water	3. Low Cost: $463 per ac-ft (raw), or $789 per ac-ft (if treated).
b. Environmental factors:	
1. Instream flows	1. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
2. Bay and estuary inflows	2. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
3. Wildlife habitat	3. Negligible impacts.
4. Wetlands	4. Negligible impacts.
5. Threatened and endangered species	5. Negligible impacts.
6. Cultural resources	6. Cultural resources will have to be surveyed and avoided.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low impacts. a. Total dissolved solids are generally high and may require blending with higher quality water. b. High salinity is a potential concern to address during the early phases of project development. c. Negligible impacts. d-e. Groundwater may contain high chloride and bromide levels and may require blending with higher quality water. f-i. Negligible impacts.
c. Impacts to State water resources	• No negative impacts on water resources other than the Gulf Coast Aquifer • Potential benefit to Nueces Estuary from increased freshwater return flows
d. Threats to agriculture and natural resources in region	• May slightly increase pumping costs for agricultural users in the area due to localized drawdowns
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable to groundwater sources
h. Third party social and economic impacts from voluntary redistribution of water	• May require the purchase of groundwater rights
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None

Table 11.14. Evaluation Summary of the Alternative for Groundwater Export Projects for the Gulf Coast Aquifer

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 18,000 ac-ft/yr.
2. Reliability	2. Water Quality: Fair.
3. Cost of treated water	3. Cost: $527 per ac-ft (raw), or $853 per ac-ft (treated).
b. Environmental factors:	
1. Instream flows	1. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
2. Bay and estuary inflows	2. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
3. Wildlife habitat	3. Negligible impacts.
4. Wetlands	4. Negligible impacts.
5. Threatened and endangered species	5. Negligible impacts.
6. Cultural resources	6. Cultural resources will have to be surveyed and avoided.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Negligible impacts. a. Low to moderate impact. b. Low to moderate impact. c. No impact. d. Low to moderate impact. e. Low to moderate impact. f. Low to moderate impact. g-h. Low to moderate impact associated with mining. i. Boron may be a potential water quality concern.
c. Impacts to State water resources	• No negative impacts on water resources other than the Gulf Coast Aquifer • Potential benefit to Nueces Estuary from increased freshwater return flows
d. Threats to agriculture and natural resources in region	• May slightly increase pumping costs for agricultural users in the area due to localized drawdowns
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable to groundwater sources
h. Third party social and economic impacts from voluntary redistribution of water	• May require the purchase of groundwater rights
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities with local resources
j. Effect on navigation	• None

11.4.3 Potential Aquifer Storage and Recovery (from the Gulf Coast Aquifer) (2006 Plan- Recommended WMS)

A previous Region N evaluation considered ASR operated on a multi-year basis and uses a dual-purpose well, or well field, to inject treated water into the Gulf Coast aquifer for storage. The water would be recovered at a later date and evaluated for increased yield to the CCR/ LCC/Lake Texana System on a long-term basis. The option evaluated would function as a regional facility in the Robstown-Driscoll area on a long-term cycle, at the proposed location shown in Figure 11.12. The system would serve customers in the City of Corpus Christi area with a reserve of water for drought or emergencies.

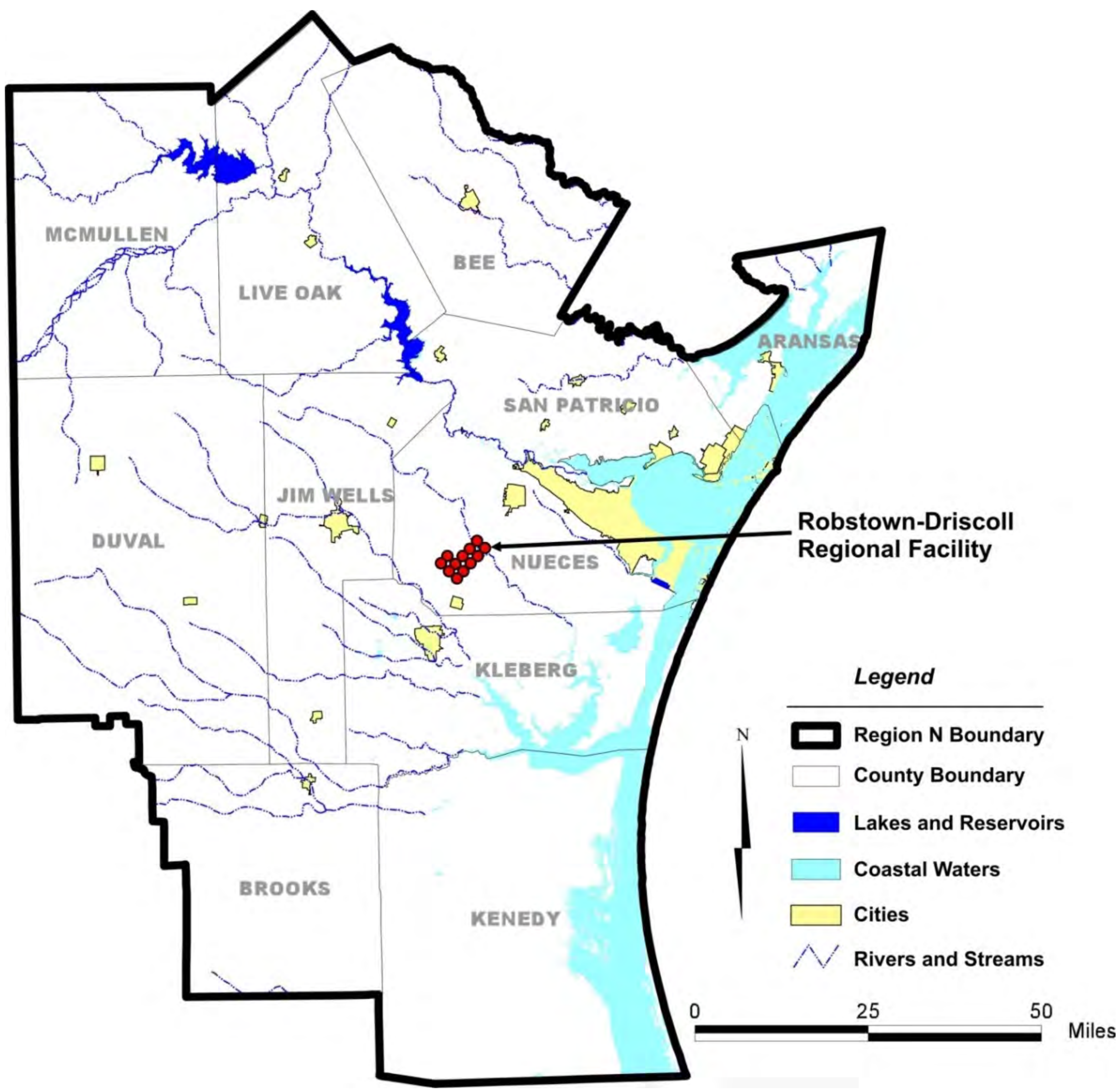

Figure 11.12. Location of ASR Facility

It was initially believed that water savings would be achieved by reduced evaporation from the CCR/LCC Reservoirs and by recovery of water when the CCR/LCC System is spilling. However, after numerous model simulations, it was determined that the best ASR can provide is a yield equal to the yield of the system without ASR. The multi-year ASR operation was not recommended as a viable management strategy to provide additional supply to the CCR/LCC/ Texana water supply system so costs are not included. A summary of the Robstown-Driscoll regional ASR option that was studied is provided in Table 11.15.

Table 11.15.
Evaluation Summary of the Robstown-Driscoll Regional ASR Facility

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Very limited firm yield.
2. Reliability	2. Not applicable.
3. Cost of treated water	3. Unit cost would be high.
b. Environmental factors:	
1. Instream flows	1. Minor impacts during construction of wells and pipelines.
2. Bay and estuary inflows	2. None or low impact.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. None or low impact.
6. Cultural resources	6. Cultural resources survey will be needed to avoid impacts to any site.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other constituents	7. None or low impact. b. The proposed Robstown-Driscoll Regional Facility has slightly saline water. This is not expected to significantly affect recovery of water.
c. Impacts to State water resources	• No negative impacts
d. Threats to agriculture and natural resources in region	• Negligible
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Not applicable
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Increases utilization of water treatment and transmission facilities
j. Effect on navigation	• None

11.4.4 CCR/LCC System Yield Recovery (2011 Plan- considered WMS)

In this water management strategy evaluated during previous planning efforts, the Corpus Christi Water Supply Model (previously identified as the NUBAY model) was used to evaluate the increase in CCR/LCC System firm yield due to alternative reservoir operating policies regarding freshwater inflows to upper Nueces Bay and Estuary. In the analysis, it was assumed that effluent from the City of Corpus Christi's wastewater treatment plants (WWTP) would be diverted to the Rincon Delta in exchange for freshwater pass-throughs from the CCR/LCC System. Three scenarios for the additional effluent diversions were analyzed: 4 mgd from Allison WWTP (no additional infrastructure needed), 9 mgd from Allison and Broadway WWTPs (shown in Figure 11.13), and 20 mgd from Allison, Broadway and Greenwood WWTPs (shown in Figure 11.14).

The three scenarios were costed for delivery of additional wastewater effluent from the City's WWTPs to the Rincon Delta. Scenario 1 (4 mgd) requires no construction of new facilities, only increased pumping and O&M costs ($5.57/ac-ft) for the increased diversion. The total project cost for building the transmission facilities for Scenario 2 (9 mgd) comes to $35,287,000 with an annual cost of $3,547,000. The estimated project cost associated with Scenario 3 (20 mgd) is $47,107,000 resulting in an annual cost of $5,120,000. A summary of these three CCR/LCC system recovery options is provided in Table 11.16.

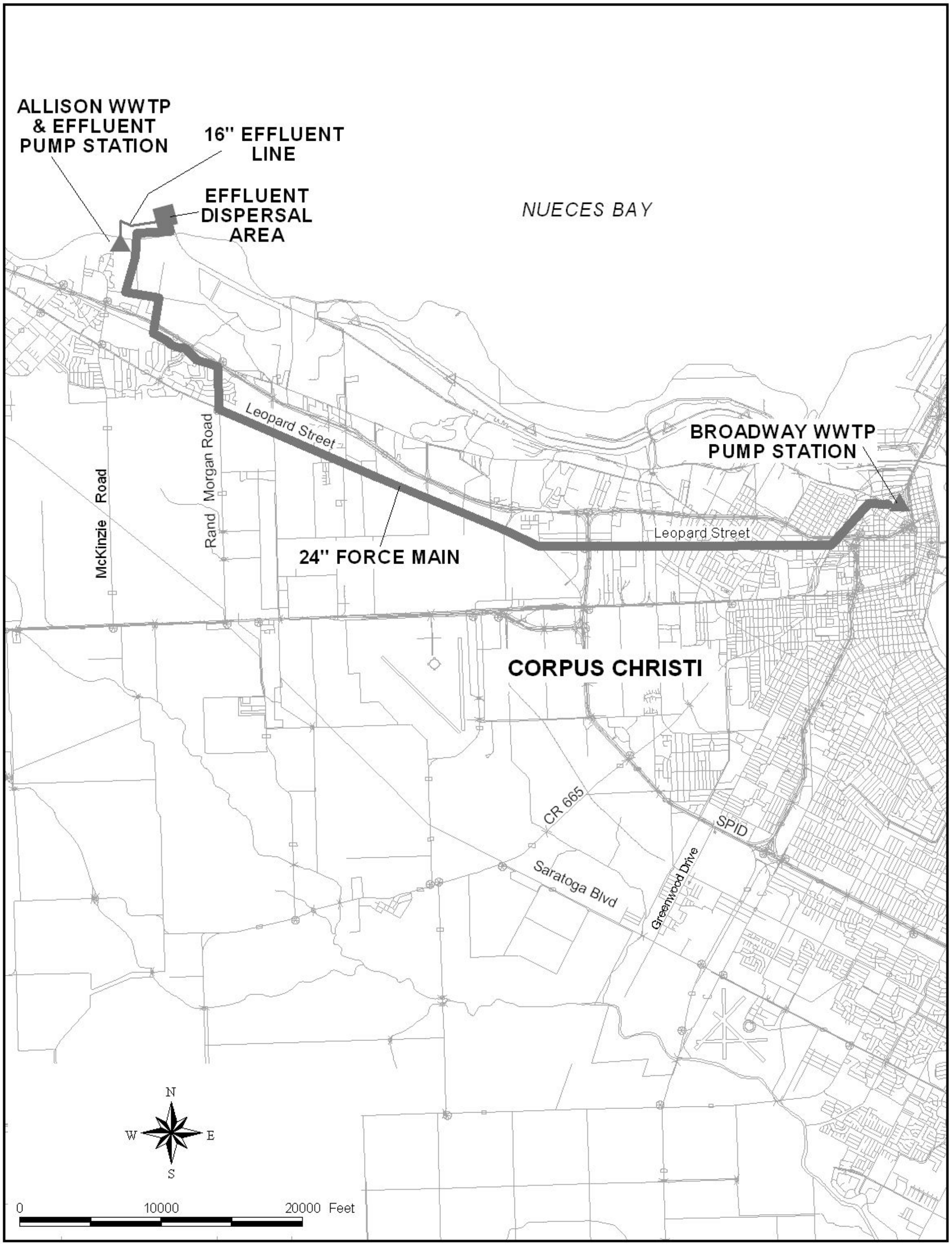

Figure 11.13.
Effluent Diversion Scenario 2

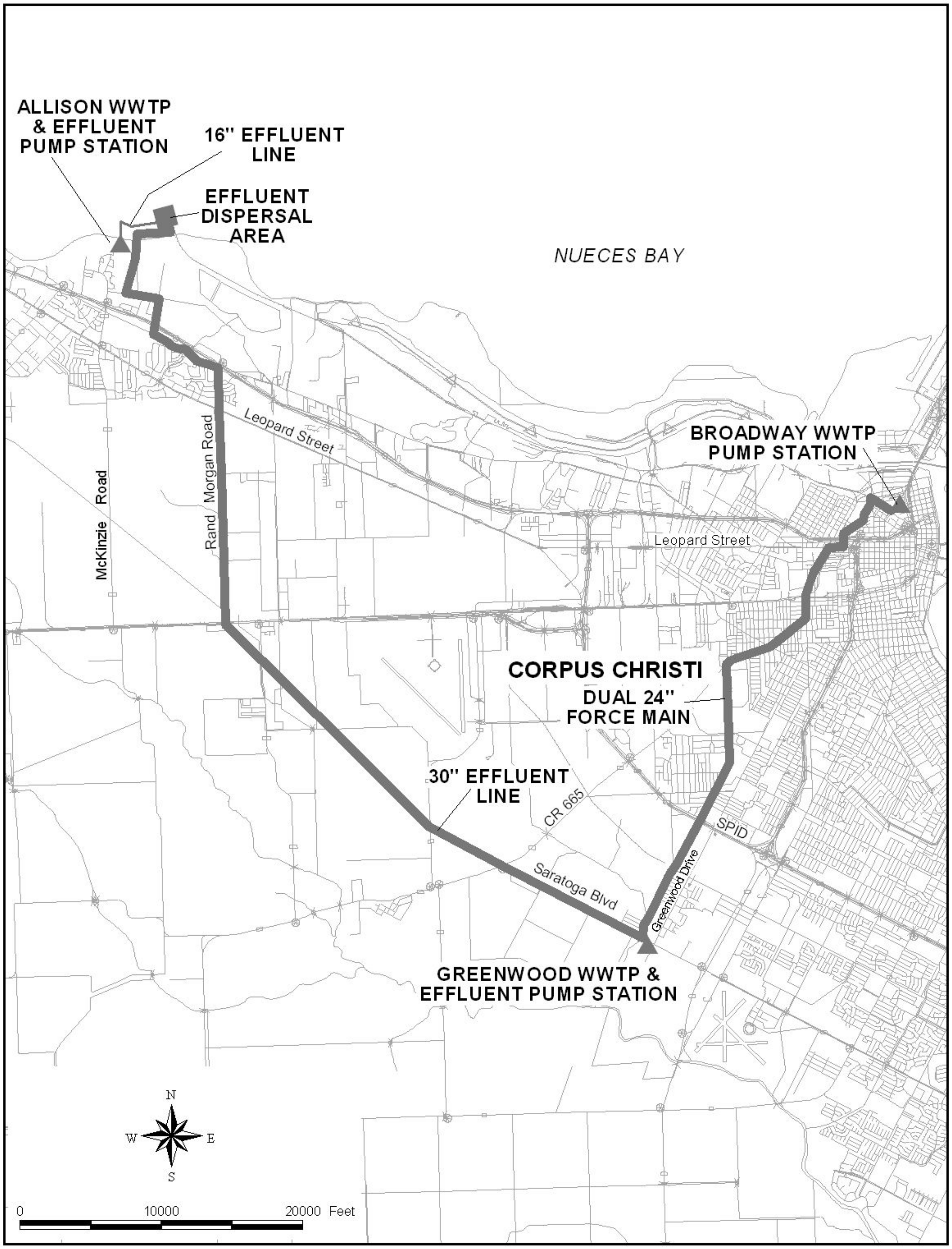

Figure 11.14.
Effluent Diversion Scenario 3

Table 11.16.
Evaluation Summary of Modifications to CCR/LCC System Recovery

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 7,100 to 13,100 ac-ft/yr (in 2010).
2. Reliability	2. Good reliability.
3. Cost of treated water	3. Generally low cost; between $4 and $563 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Increases in freshwater inflow to Upper Nueces Bay. Potential environmental impact due to reduced freshwater inflow to Estuary.
2. Bay and estuary inflows	2. Positive impacts to biological activity in the Nueces Estuary & Upper Nueces Delta by increasing returned flows. Potential environmental impact due to reduced freshwater inflow to Estuary.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. Positive impacts to biological activity in the Nueces Estuary & Upper Nueces Delta by increasing returned flows. Potential environmental impact due to reduced freshwater inflow to Estuary.
6. Cultural resources	6. Cultural resources survey will be needed to avoid any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. The City's Integrated Plan provides ongoing studies of water quality issues of the Nueces Delta. a. Dissolved solids are a concern to be addressed with further studies. b. Salinity is a concern to be addressed with further studies. c. Bacteria is a concern to be addressed with further studies. d. Chlorides are a concern to be addressed. e-h. None or low impact. i. Alkalinity a concern and will need to be addressed.
c. Impacts to State water resources	• No negative impacts on other water resources • Potential benefit to Nueces Estuary from increase in freshwater return flows
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Potentially could require the transfer of water from the Nueces River Basin to the San Antonio-Nueces Coastal Basin
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides enhanced recreational opportunities (birding in Upper Nueces Delta)
j. Effect on navigation	• None

11.4.5 Pipeline between Choke Canyon Reservoir and Lake Corpus Christi (2011 Plan- Recommended WMS)

A March 2008 channel loss study showed that losses in the natural streams between CCR and LCC could possibly be prevented by use of a transmission pipeline. A previously presented pipeline went southeasterly from CCR crossed the Nueces River, and terminated on the upper west side of LCC, as shown in Figure 11.15. The pipeline operation would require an intake at CCR and an outlet structure at LCC. CCR is required to continue its release of 33 cfs for senior water rights and environmental considerations even with the pipeline in operation to deliver water supply releases.

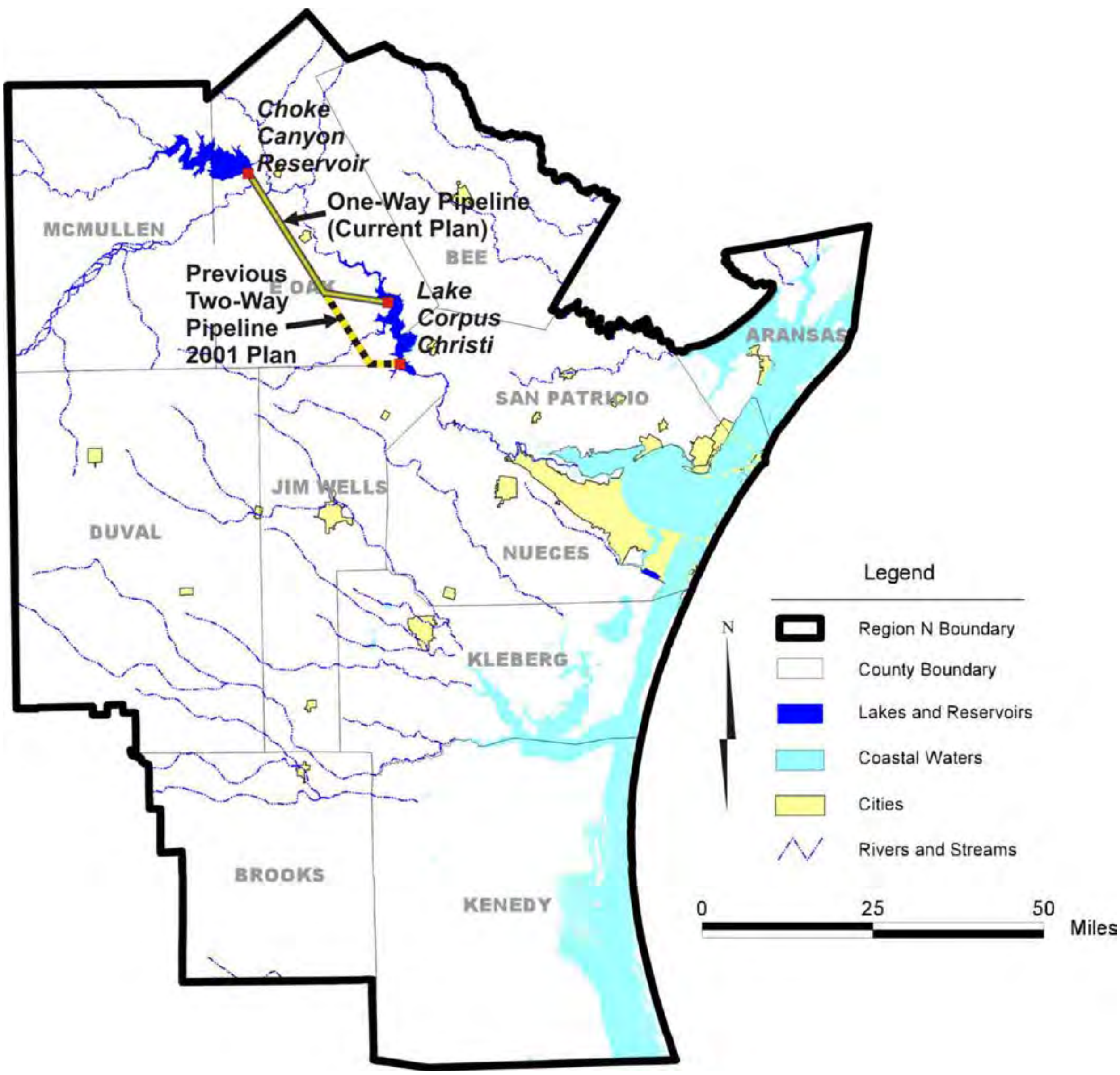

Figure 11.15.
Pipeline between Choke Canyon Reservoir and Lake Corpus Christi

Simulations were made for the historical period from 1934 to 2003 using the City of Corpus Christi's Phase IV Operations Plan, the 2001 TCEQ Agreed Order, and 2010 reservoir sedimentation conditions. Although a 300 cfs CCR/LCC pipeline is capable of delivering 39,500 ac-ft/yr as a stand-alone project, when operated conjunctively with the Nueces OCR it would be expected to provide a firm yield of 33,700 ac-ft/yr (or a reduction of 5,800 ac-ft/yr). A pipeline linking CCR to LCC with a delivery rate of 300 cfs is estimated to provide a firm yield of 33,700 ac-ft at unit raw water cost of $402 per ac-ft ($1.23 per 1,000 gallons). With treatment costs assumed at $326 per ac-ft, treated water supplies from this project would be $728 per ac-ft ($2.23 per 1,000 gallons). With federal or state participation in the project, the firm yield is reduced to 21,905 ac-ft/yr at an overall treated water cost of $588 per ac-ft. A summary of the CCR/LCC pipeline, with federal participation, is provided in Table 11.17.

Table 11.17. Evaluation Summary for Pipeline between Choke Canyon Reservoir and Lake Corpus Christi

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Reduced Firm Yield (with Federal or State participation): 21,905.
2. Reliability	2. Good reliability.
3. Cost of treated water	3. Generally low raw water cost of $262 per ac-ft with Federal or State participation. With $326 added for treatment, cost of treated water is $588 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Reduction in streamflows between Choke Canyon Reservoir and Lake Corpus Christi.
2. Bay and estuary inflows	2. Increase in streamflows below Lake Corpus Christi and freshwater inflows to Nueces Estuary.
3. Wildlife habitat	3. Low impact to wildlife habitat.
4. Wetlands	4. Low impact to wetlands.
5. Threatened and endangered species	5. Low impact to threatened and endangered species.
6. Cultural resources	6. Cultural resources survey needed to avoid impacts.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low impact to water quality. a-b. Will improve dissolved solids and salinity levels at CCR by reducing evaporation from reservoir.
c. Impacts to State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Reduces losses in the CCR/LCC System
j. Effect on navigation	• None

11.4.6 Nueces Off-Channel Reservoir near Lake Corpus Christi (2011 Plan- Recommended WMS)

The Coastal Bend Region relies predominantly upon surface water supplies from two reservoirs located in the Nueces River Basin: Choke Canyon Reservoir (CCR) and Lake Corpus Christi (LCC). The yield of the system is affected by the storage capacity of LCC and its limited ability to capture a significant portion of large storm events that travel down the Nueces River. The Nueces OCR, at the proposed location shown in Figure 11.16, could be operated to capture water that would otherwise spill from LCC while still maintaining desired freshwater inflows to the Nueces Bay and Estuary (B&E) and could potentially be operated to reduce flood events downstream of LCC.

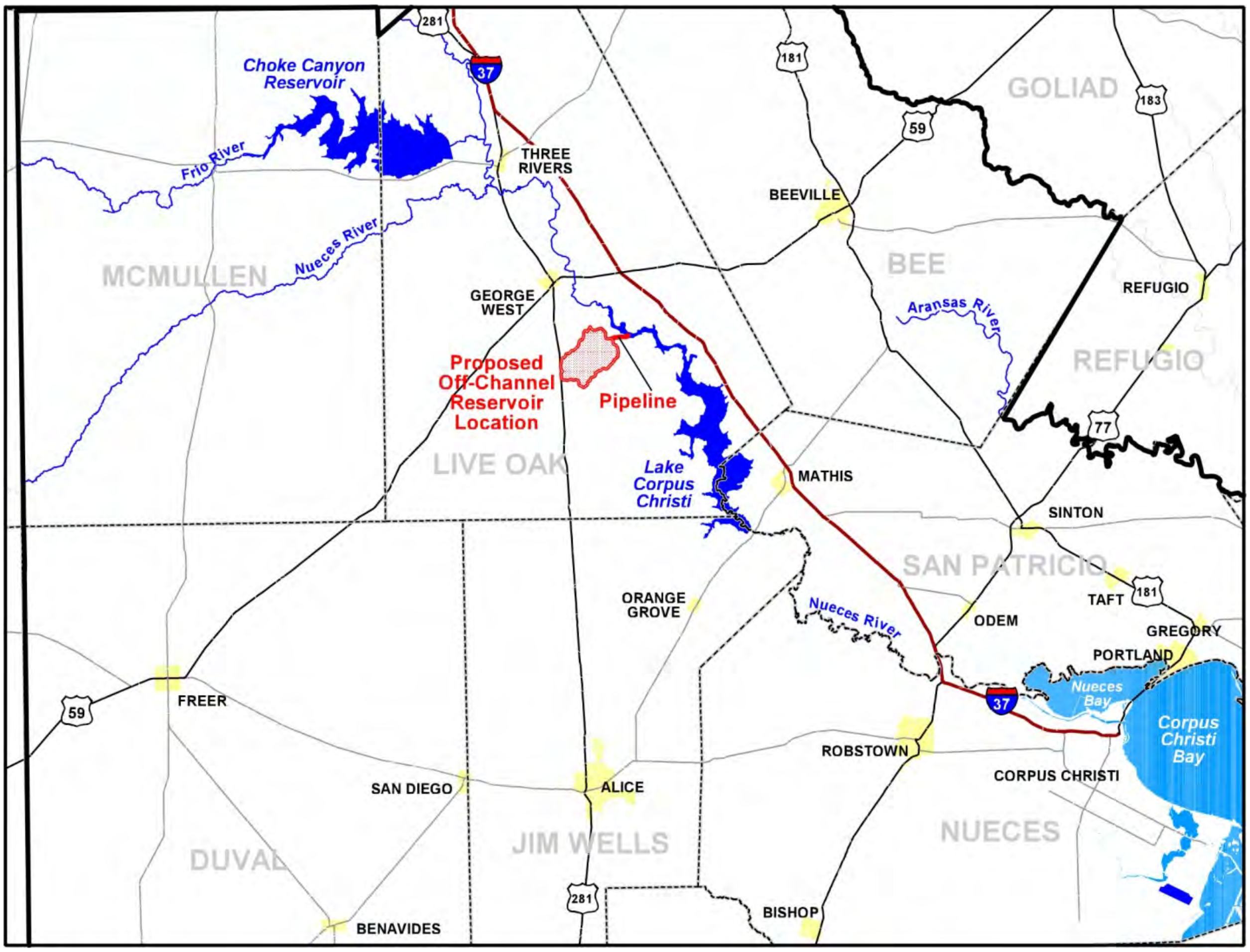

Figure 11.16.
Nueces Off-Channel Reservoir and Pipeline to Lake Corpus Christi

Operational parameters for the reservoir and pipeline operations at the Nueces OCR were developed to identify the optimum set of LCC elevation triggers, pipeline capacity and Nueces OCR storage capacity. Of the 24 combinations of reservoir size and pipeline delivery rate, the preferred size for a Nueces OCR is 280,000 ac-ft with a pipeline delivery rate between 1,250 cfs and 1,500 cfs. A 280,000 ac-ft Nueces OCR at pipeline delivery rate of 1,250 cfs is estimated to provide a firm yield of 46,677 ac-ft at unit raw water cost of $570 per ac-ft ($1.75 per 1,000 gallons). A 280,000 ac-ft Nueces OCR at a pipeline delivery rate of 1,500 cfs is estimated to provide a firm yield of 48,296 ac-ft at unit raw water cost of $598 per ac-ft ($1.48 per 1,000 gallons). With federal or state participation in the project, the firm yield is reduced to 30,340 or 31,392 ac-ft/yr depending on diversion rate at an overall treated water cost between $389 and $409 per ac-ft. A summary of the Nueces off-channel reservoir, with federal participation, is provided in Table 11.18.

Table 11.18. Evaluation Summary for Nueces Off-Channel Reservoir 280,000 ac-ft With Pipeline Delivery of 1,250 or 1,500 cfs

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Reduced Firm Yield (with Federal or State participation): 30,340 to 31,392 ac-ft/yr.
2. Reliability	2. Firm Supply.
3. Cost of treated water	3. Generally low raw water cost between $389 to $409 per ac-ft. With $326 added for treatment, cost of treated water is $715 to $734 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Generally decreases streamflows below LCC.
2. Bay and estuary inflows	2. Slight decrease in freshwater inflows to Nueces Bay. Increase freshwater inflows to Nueces Estuary, primarily attributable to increased return flows with increased water demands.
3. Wildlife habitat	3. Some impact to wildlife habitat. Inundated land area for off-channel reservoir.
4. Wetlands	4. Low impact to wetlands.
5. Threatened and endangered species	5. Low impact to threatened and endangered species.
6. Cultural resources	6. No cultural resources identified in project area based on Texas Historical Commission data.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Minimal impact to water quality.
c. Impacts to State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• Benefits with higher LCC water level with 83 ft-msl trigger
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Maximizes opportunities to capture water from a large drainage area
j. Effect on navigation	• None

11.4.7 Federal or State Opportunities to Participate in Regional Projects (2011 Plan- Recommended WMS)

Four projects considered as separate water management strategies for the 2011 plan (Nueces off-channel reservoir, CCR/LCC pipeline, seawater desalination, and brackish groundwater desalination) include discussion of opportunities for federal or state participation. Some of these projects could potentially serve to mitigate the effects of the recharge enhancement projects. Costs to implement these projects could potentially be reduced through federal or state participation. For example, the total project cost of the Nueces off-channel reservoir was estimated at $300,577,000 for a yield of 46,677 ac-ft/yr. When considering annual program costs, the unit cost would be approximately $896 per ac-ft for treated water supplies. Assuming federal funding participation of 65%, the total project cost would be reduced to $105,201,950. For the purposes of the plan, it was assumed that with federal or state participation, 35% of the total project water supply is dedicated for ecosystem restoration or other federal or state designnated purpose. The annual cost (including operations and maintenance costs and reduced debt service) would be $11,805,950, which results in a unit cost of $389 per ac-ft for raw water supplies ($715 per ac-ft for treated water supplies), or about 80% of the unit cost without federal participation.

For brackish groundwater and seawater desalination options, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or other purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore was not recommended for these water management strategies in the 2011 Plan.

11.4.8 Palmetto Bend Stage II (Lavaca-Navidad River Basin) (2011 Plan-Recommended WMS)

This strategy addressed an on-channel option for stage II of Lake Texana. Palmetto Bend Stage II was assumed to be constructed at the alternative site located approximately 1.4 miles upstream of the original site, as shown in Figure 11.17. Target inflow was defined based on criteria established for salinity and nutrient inflow, in addition to necessary long-term inflow to produce 98% of maximum population for nine key estuarine species.

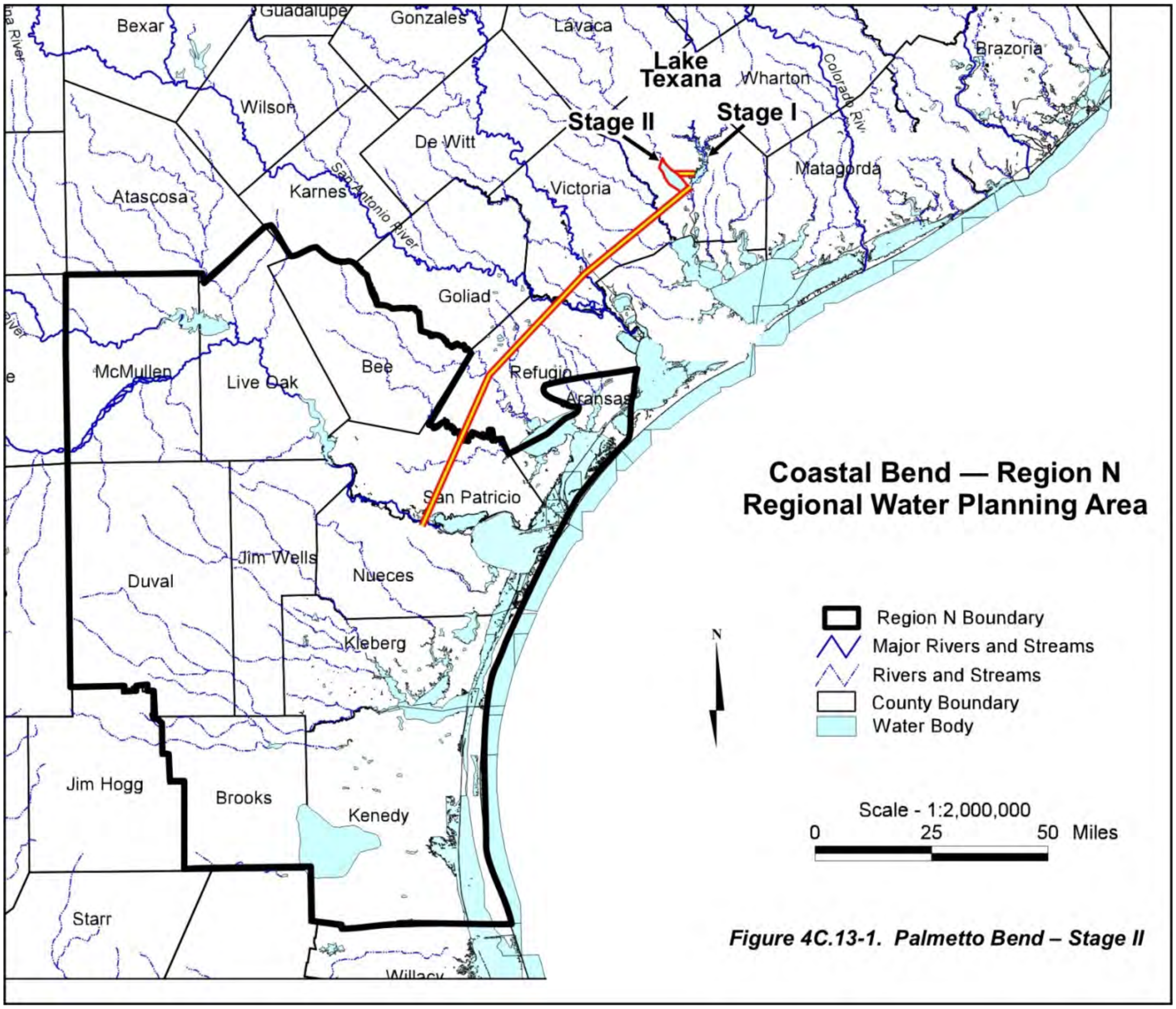

Figure 11.17.
Palmetto Bend – Stage II

The firm yield of Palmetto Bend Stage II was estimated using the TCEQ Lavaca River Basin water availability model (BOR, 2001; February 24, 2003 version) data sets and the Water Rights Analysis Package. The development of Palmetto Bend Stage II would result in approximately 22,964 ac-ft of water. The total project cost with the reservoir is $232,828,000. The total annual cost of constructing Palmetto Bend Stage II and delivering the firm yield to Corpus Christi is $20,377,000. Dividing annual cost by the Year 2060 firm yield of 22,964 equated to an annual cost of $887 per ac-ft or $2.72 per 1,000 gallons as shown in Table 11.19.

Table 11.19. Evaluation Summary of Palmetto Bend Stage II

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: 22,964 ac-ft/yr.
2. Reliability	2. Good reliability.
3. Cost of treated water	3. Raw water cost is $887 per ac-ft. Assuming $326 per ac-ft for treatment, treated water cost is $1,213 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Reduces instream flows. Stage II releases in accordance with the Consensus Criteria were considered prior to determining yield.
2. Bay and estuary inflows	2. Negligible impact to Lavaca Bay.
3. Wildlife habitat	3. Construction of reservoir may have negative impact on wildlife habitat.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. No federal or state protected species are known to be present within the reservoir area.
6. Cultural resources	6. Cultural resources will need to be surveyed and mitigation for significant sites before this project is implemented.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Impacts to water quality will need to be evaluated prior to implementing project.
c. Impacts to State water resources	• No apparent negative impacts on other water resources • Potential benefit to river segment before dam due to increased low flows
d. Threats to agriculture and natural resources in region	• Purchase of reservoir land will result in reduced agricultural uses
e. Recreational impacts	• Increase in recreational use opportunities
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Requires transfer of water from Lavaca-Navidad River Basin to Nueces River Basin
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• Pipeline from Stage II to Lake Texana may impact wildlife habitat. Field surveys should be conducted to minimize impacts to protected species and vegetation.

11.4.9 Brush Management (2011 Plan- considered WMS)

The interest in brush management as a means to increase water supply has its roots in: 1) the belief that Texas rangelands changed after settlement and use by Europeans from predominantly open grasslands to increasing domination of brush; and 2) the significantly greater interception of water by brush than grasses. Interception losses in Texas range from 14 percent for grass to 46 percent for live oak and 73 percent for juniper.[2] Thus, a strategy of limiting brush cover and increasing grass cover would presumably increase runoff and/or deep percolation. In terms of water supply, yield is the quantity of water available in a year for municipal, industrial, agricultural, and other uses. However, increasing the quantity of water that is not intercepted by brush on rangelands does not necessarily increase yield as defined by water supply. This is because there are other factors that could prevent this water from being available.

The cost of enhanced water yield from brush management cannot be estimated for the Coastal Bend Region because associated hydrologic data are not adequate to determine any increases in water supply yield for Choke Canyon Reservoir/Lake Corpus Christi system. However, the costs of brush management can be reasonably estimated because of the studies of brush management practices in Texas. The average annual cost per acre for each county was determined by dividing estimated annual costs by the estimated acreages which are the estimated areas that might increase runoff and/or deep percolation as a result of brush management. Estimated annual costs of brush management in counties in the Coastal Bend Region range from $881,269 in Aransas County to $15.9 million in Kenedy County. A summary of the brush management option previously studied is provided in Table 11.20.

[2] Thurow, T. L. and Hester, J. W., "How an Increase in Juniper Cover Alters Rangeland Hydrology," Proceedings Juniper Symposium, Texas A&M Agricultural Experiment Station Technical Report 97-1, 1997.

Table 11.20.
Evaluation Summary of Brush Management to Enhance Water Supply Yield

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Indeterminate reliable quantity.
2. Reliability	2. Unknown.
3. Cost of treated water	3. Unknown.
b. Environmental factors:	
1. Instream flows	1. May increase water runoff and instream flows.
2. Bay and estuary inflows	2. May increase bay and estuary inflows.
3. Wildlife habitat	3. Brush control techniques may adversely affect existing wildlife populations.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. May have negative effects on habitats for endangered species.
6. Cultural resources	6. Chemical brush management methods may result in residual chemicals in aquifers and streams.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. None or low impact.
c. Impacts to State water resources	• No apparent negative impacts on other water resources • Potential benefit to Gulf Coast and Carrizo-Wilcox water resources due to increased water for recharge • Potential benefit to surface reservoirs from increased runoff
d. Threats to agriculture and natural resources in region	• Potential threats to habitat due to removal of brush
e. Recreational impacts	• Could impact hunting
f. Equitable comparison of strategies	• Cost model for brush management is based on literature values • No estimate made for cost of water supply yield because yield not determined
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None

11.4.10 Weather Modification (2011 Plan- considered WMS)

Cloud seeding with silver iodide increases rain generated by these clouds by extending the life of the clouds, by allowing the clouds to enlarge laterally so that they cover more area, and by slightly increasing the height of the clouds. The current weather modification programs in South Central Texas and counties where they operate are presented in Figure 11.18. Although these weather modification projects could potentially provide additional water opportunities for

Region N, to determine these benefits would require additional studies to translate increased annual flow to Choke Canyon Reservoir and Lake Corpus Christi to firm yield.

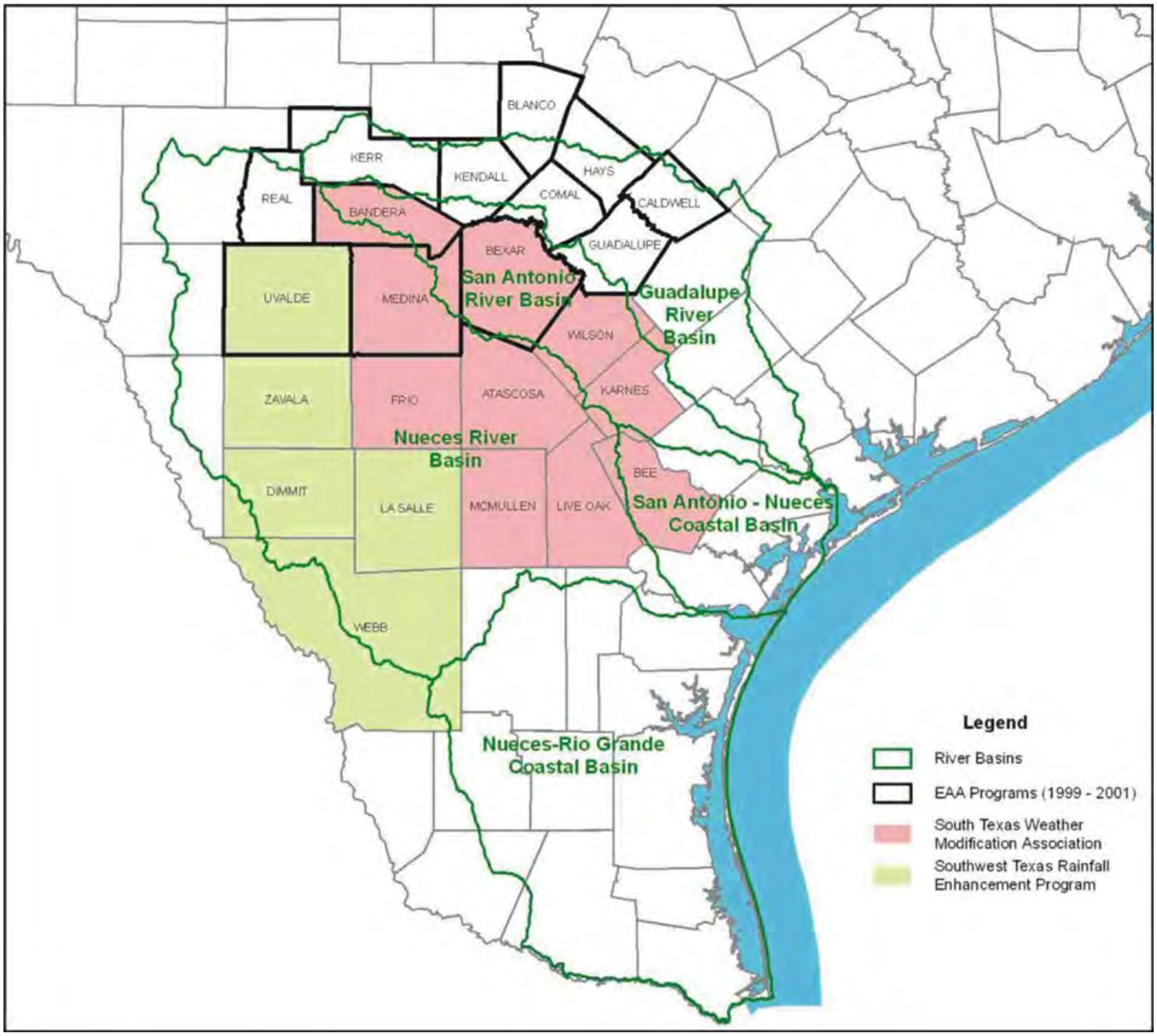

Figure 11.18.
South Central Texas Weather Modification Programs

The 2006 South Central Texas Regional Water Plan estimated unit water costs for weather modification which ranged from $74-$77 per ac-ft.[3] These costs are based on increases in sustained yield from the Edwards Aquifer (1,916 ac-ft/yr and 488 ac-ft/yr attributed to weather modification in the Nueces Basin and Blanco Basin, respectively). For the Nueces Recharge Basin, the total annual cost for a weather modification program for Edwards, Real, Kinney, and Uvalde Counties (3,693,440 acres) is estimated at $147,740, assuming an annual cost of $0.04 per acre. For the Blanco Recharge Basin, the total annual cost for a weather modification

[3] These unit costs were not updated by the South Central Texas Regional Water Planning Group as part of the 2011 planning cycle. However, using the updated Construction Cost Index (CCI) value, these costs would likely be 31 to 32% higher if updated to September 2008 dollars.

program for Blanco and Hays Counties (901,120 acres) is estimated at $36,050, assuming an annual cost of $0.04 per acre. A summary of the weather modification option previously studied is provided in Table 11.21.

Table 11.21.
Evaluation Summary of Weather Modification to Enhance Water Supplies

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Variable, indeterminate quantity.
2. Reliability	2. Low, uncertain timing.
3. Cost of treated water	3. Low cost.
b. Environmental factors:	
1. Instream flows	1. May slightly increase instream flows.
2. Bay and estuary inflows	2. May slightly increase bay and estuary flows.
3. Wildlife habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and endangered species	5. None or low impact.
6. Cultural resources	6. None or low impact.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low impact with potential for limited benefits.
c. Impacts to State water resources	• No apparent negative impacts on other water resources • Potential benefit to Gulf Coast and Carrizo Aquifers water resources due to increased water for recharge • Potential benefit to farmers and ranchers through increased rainfall
d. Threats to agriculture and natural resources in region	• Potential threats due to limited potential for increased flooding
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Cost reported in annual unit area cost only
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Improvement over existing conditions
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• None

11.4.11 Desalination (2011 Plan- Recommended WMS)

Both the 2006 and 2011 plans considered desalting seawater from the Gulf of Mexico as a potential source of freshwater supplies for municipal and industrial uses at the location of Barney M. Davis Power Station in Corpus Christi. Strategies were evaluated for a base option and an alternative option each at 4 different yields (25 mgd, 50 mgd, 75 mgd, and 100 mgd). The base option includes a 29-mile pipeline from the desalination plant to the Stevens WTP or 5-mile pipeline to a delivery location towards the south of the City's service area. Once the desalted water is pumped to the Stevens WTP, it can be mixed with treated surface water and put into the City's distribution system. The alternative option takes advantage of the City's plans to develop a new water distribution center on the south side of town. If developed, the desalination plant could pump water 5 miles to the proposed distribution center, saving capital and operating costs in transmission of the potable desalt water into the City's system.

For the base option, project costs would range from $324,634,000 to $940,565,000, increasing from the 25 mgd to the 100 mgd option. Annual costs follow a similar pattern and range from $54,014,000 to $177,700,000. The unit costs per ac-ft of supply range from $1,587 to $1,929 per ac-ft. For the alternative option, project costs would range from $260,914,000 to $794,207,000, increasing from the 25 mgd to the 100 mgd option. Annual costs follow a similar pattern and range from $47,498,000 to $151,061,000. The unit costs per ac-ft of supply range from $1,349 to $1,696. A summary of the seawater desalination options previously studied is provided in Table 11.22.

A 2006 evaluation considered including brackish groundwater as a raw water source or as a supplement to seawater. Three options are included for utilizing the estimated 18 mgd brackish groundwater yield from the northwest and south central well fields, as shown in Figure 11.19. The first option is a combination of 18 mgd of brackish groundwater and 23 mgd of seawater to produce a finished water flow of 25 mgd. The second option is a combination of 18 mgd of brackish groundwater and 10 mgd of seawater to produce a finished water flow of 19 mgd. The third option is desalination of the 18 mgd of brackish groundwater without blending any seawater to produce a finished water flow of 14 mgd.

Two engineering options were considered, a base option with a 29-mile pipeline and an alternate option with a 5-mile pipeline. For the base option, project costs would range from $120,420,000 to $201,474,000, increasing from the 14 mgd to the 25 mgd option. Annual costs follow a similar pattern and range from $13,708,000 to $27,608,000. The unit costs per ac-ft of supply range from $874 to $986 in the same order. For the alternative option, project costs would range from $152,560,000 to $84,420,000, increasing from the 14 mgd to the 25 mgd option. Annual costs follow a similar pattern and range from $23,371,000 to $10,630,000. The unit costs per ac-ft of supply range from $835 to $678 in the same order. A summary of the combined brackish groundwater and seawater desalination option previously studied is provided in Table 11.23.

Table 11.22. Evaluation Summary of the Seawater Desalination Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Variable, ranges from 28,000 to 112,000 ac-ft/yr (for 2006 Plan); actual water supply virtually unlimited.
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Generally high cost; between $1,349 and $1,929 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows	2. Environmental impact to estuary.
3. Wildlife habitat	3. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated.
c. Impacts to State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Consideration of water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way

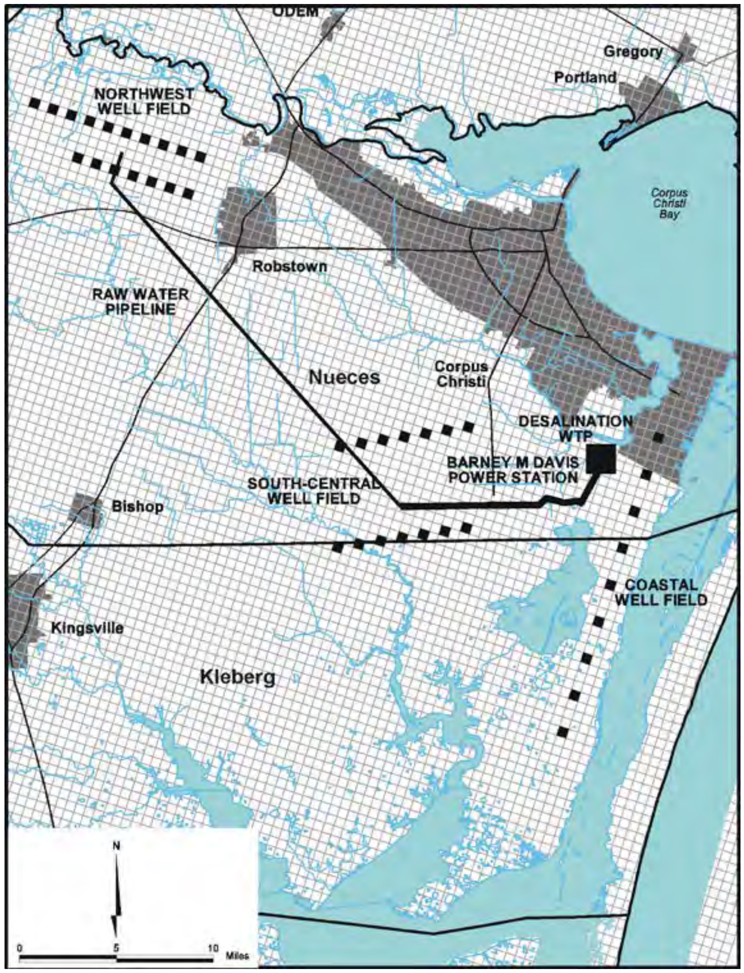

Figure 11.19.
Combined Seawater and Brackish Groundwater Desalination at Barney M. Davis Power Plant

Table 11.23. Summary Evaluation of the Combined Seawater and Brackish Groundwater Desalination Option

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Variable, ranges from 15,680 to 28,000 ac-ft/yr (for 2006 Plan); actual water supply limited by brackish groundwater yield with maximum product water yield of 25 mgd.
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Generally high cost; between $986 to $678 per ac-ft. Cost could potentially be reduced through Federal participation as may be available through the USACE Nueces River Basin Feasibility Study.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows	2. Environmental impact to estuary.
3. Wildlife habitat	3. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated.
c. Impacts to State water resources	• No negative impacts on other water resources other than lowering Gulf Coast Aquifer levels
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline • Insignificant due to water use since very little of water is suitable for use by agriculture
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions. Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project.
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None

11.4.12 Sediment Removal in Lake Corpus Christi (2001 Plan- considered WMS)

The accumulation of sediment in Lake Corpus Christi is a long-term concern. The 2001 Costal Bend Regional Water Plan studied a water supply option that involved the dredging of Lake Corpus Christi. A maintenance dredging program to offset the annual sedimentation rate of 1,223 ac-ft will require that approximately 2 million cubic yards (CY) (in situ volume) of sediment be dredged each year. An accelerated dredging program to restore Lake Corpus Christi storage capacity to 1959 conditions (302,160 ac-ft) will require that approximately 163 million CY (in situ volume) of sediment be dredged by the year 2020. The accelerated program would require the removal of about 6 million CY (in situ volume) of sediment each year. A cutterhead suction dredge was assumed for the analysis.

Costs were estimated using unit costs for each element of construction from the 1997 White Rock Restoration Project. The cost of mobilization and demobilization was calculated as $200,000. The dredging was expected to cost $6,505,640, booster stations and piping was projected at $3,500,000 and $4,399,000, respectively. Finally the disposal area costs were calculated to be 2,300,000 for a total project cost of $16,904,640 for 3,235,000 cubic yards of dredging. A summary of the sediment removal in LCC option previously studied is provided in Table 11.24. Note: An updated volumetric survey completed by the TWDB resulted in a lower sedimentation rate estimate in LCC, which may reduce the sediment removal quantity and increase unit costs.

Table 11.24.
Evaluation Summary of the Sediment Removal in Lakes in Corpus Christi

Impact Category	Comment(s)
a. Quantity, reliability, and cost of treated water	• Long-term yield (30 yr) = 9,000 ac-ft/yr • High cost: $3,404 to $3,737 per ac-ft
b. Environmental factors	• Disturbance of sediments in LCC • Disposal of removed sediments • Cultural resources will need to be surveyed and avoided, where possible
c. State water resources	• Potential negative impacts on water quality in LCC during dredging
d. Threats to agriculture and natural resources in region	• Potential threats to habitat due to disposal of dredge material
e. Recreational	• None
f. Comparison and consistency equities	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third-party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides for improved efficient use of LCC
j. Effect on navigation	• None

11.4.13 Summary of Phase I Studies - 2011 Coastal Bend Regional Water Plan

During the 3rd round of regional water planning, the Texas Water Development Board provided funding to regional water planning groups to analyze and further evaluate feasible water management strategies based on competitive funding proposals and selection. The Coastal Bend Regional Water Planning Group receiving funding for 5 studies:

- Study 1 – Evaluation of Additional Potential Regional Water Supplies for Delivery through the Mary Rhodes Pipeline, Including Gulf Coast Groundwater and Garwood Project
- Study 2 – Optimization and Implementation Studies for Off-Channel Reservoir
- Study 3 – Implementation Analysis for Pipeline from CCR to LCC, Including Channel Loss Study Downstream of Choke Canyon Reservoir
- Study 4 – Water Quality Modeling of Regional Water Supply System to Enhance Water Quality and Improve Industrial Water Conservation
- Study 5 – Region-Specific Water Conservation Best Management Practices (BMPs)

Evaluation of Additional Potential Regional Water Supplies for Delivery through the Mary Rhodes Pipeline, Including Gulf Coast Groundwater and Garwood Project (Study 1)

This study: 1) included an evaluation of water quality of potential new supplies; 2) identified potential blending and water chemistry issues; and 3) considered reservoir system operations with possible future supplies from the Gulf Coast Aquifer, Garwood project supplies for two delivery scenarios around and through Lake Texana, and additional Lake Texana water supplies as may be available through projects being considered by the Lavaca-Navidad River Authority.

A modified version of the Corpus Christi Water Quality and Treatment Model was utilized to analyze water quality and treatment requirements when blending different water sources. The model was developed to simulate treatment processes currently utilized at the O.N. Stevens WTP. Five blending scenarios were evaluated. The blending analysis did not indicate any large treatment issues at the O.N. Stevens WTP when blending groundwater supplies from the Gulf Coast Aquifer, surface water supplies from the Garwood Project, or additional supplies from Lake Texana with existing supplies from the Nueces River and Lake Texana.

The Corpus Christi Water Supply Model (CCWSM) was then used to evaluate various reservoir system operations and delivery scenarios with potential new supplies delivered through the MRP. System operations for five different combinations of existing and potential future water supplies through the MRP were simulated using the CCWSM at a fixed demand of 175,000 ac-ft/yr. The five operating scenario combinations considered current and potential future water supplies for delivery through the MRP and, on average, the amount of MRP capacity in use ranged from 47% to 100%. Essentially, as more water supplies are available for delivery through the MRP, the supplies needed from the Choke Canyon Reservoir and Lake Corpus Christi (CCR/LCC) System decreases for a fixed demand. This results in more water stored in the CCR/LCC System, which increases reservoir pass-throughs of freshwater for the Nueces Bay and Estuary according to provisions of the 2001 Agreed Order.

Optimization and Implementation Studies for Off-Channel Reservoir (Study 2)

The 2006 Coastal Bend Regional Water Plan (2006 Plan) and the 2007 State Water Plan included the Nueces Off-Channel Reservoir (OCR) near Lake Corpus Christi as a recommended future water management strategy for the Coastal Bend Region to meet needs by Year 2040. Federal interests are studying opportunities for flood damage reduction, ecosystem restoration, and/or water supply benefits in South Texas. During the 2007 Texas legislative session, the Nueces Off-Channel Reservoir site was designated as one of 19 unique reservoir sites in the State of Texas. The TWDB Reservoir Site Protection Study recommended the Nueces Off-Channel Reservoir as one of the top-ranked sites in Texas for protection or acquisition.

The OCR is a water management strategy that could be used to: 1) enhance the system yield of Choke Canyon Reservoir (CCR) and Lake Corpus Christi (LCC); 2) capture water that would otherwise spill from LCC; and 3) reduce flood events downstream of LCC (to a lesser extent) while still maintaining desired freshwater inflows to the Nueces Bay and Estuary pursuant to the Texas Commission on Environmental Quality (TCEQ) 2001 Agreed Order.

The 2006 Plan analysis showed the optimal size for the OCR is between 200,000 and 300,000 ac-ft, with a diversion pipeline delivery rate between 750 and 1,500 cfs.

This study included further analysis of the OCR as a water management strategy for the Coastal Bend Region. The purposes of this study were to identify a preferred location for the OCR considering potential environmental impacts, optimize its capacity and diversion pipeline delivery rate, and evaluate alternative reservoir operating policies to assist with effective management of system storage and water supply yields.

The results of this study show that the optimal size for the OCR based on acceptable cost and project yield is 280,000 ac-ft with a pipeline delivery rate of between 1,250 cfs and 1,500 cfs. The results from this study were used to update the Off-Channel Reservoir near Lake Corpus Christi water management strategy.

Implementation Analysis for Pipeline from CCR to LCC, Including Channel Loss Study Downstream of Choke Canyon Reservoir (Study 3)

The primary objective of this study was to evaluate stream flow interaction with alluvial sands of the Gulf Coast Aquifer downstream of CCR to LCC using data collected during a field channel loss study. A channel loss study was conducted from March 3-28, 2008, during a fairly wet hydrologic period with LCC water levels ranging from 93.5 ft-msl to 93.8 ft-msl (or 96.1% - 98.3% LCC water storage capacity).

An overall 87 percent delivery rate (or 13 percent channel loss) from CCR to the Nueces River at Three Rivers Gage was measured during the channel loss study. These data agree closely with the City of Corpus Christi's previously estimated 84 percent delivery factor from CCR to Three Rivers. From the Nueces River near Three Rivers to the Nueces River downstream of the confluence with Sulphur Creek near Oakville (a distance of 7.4 river miles), the data indicate between an 11 percent and 13 percent gain in stream flow. Based on this study, an overall channel loss was estimated to be between 2 and 3 percent for the 17.4 river mile stretch from CCR to the Nueces River near Sulphur Creek. This is significantly less than the results from previous studies which estimated channel losses from CCR to LCC over a distance of about 63 miles at about 37.8 percent (a delivery factor of 62.2 percent).

The groundwater and surface water interaction downstream of CCR to LCC is very complex and could vary significantly based on seasonal events, antecedent drought or wet conditions and prolonged drought or wet conditions that could impact storage in LCC. When LCC is at or near storage capacity (conservation pool elevation of 94 ft-msl), the alluvium system influenced by LCC stores water which would be expected to result in less channel losses from the Three Rivers Gage to LCC. The channel loss study was conducted when LCC was nearly full. Furthermore, after prolonged drought periods there could be less water stored in LCC and it would be expected that the alluvium system will act somewhat like a sponge and absorb streamflow traveling down the Nueces River towards LCC, resulting in higher channel losses. The results from this study were considered during the update of the Pipeline from CCR to LCC water management strategy.

Water Quality Modeling of Regional Water Supply System to Enhance Water Quality and Improve Industrial Water Conservation (Study 1)

In this study, a water quality component was added to the Corpus Christi Water Supply Model (CCWSM) to simulate chloride and TDS levels at the three water supply reservoirs and the Calallen Pool for a hydrologic period from 1934 to 2003. The CCWSM enhanced with the water quality database is capable of simulating chlorides and TDS for the existing CCR/LCC/Lake Texana system for various potential reservoir operating conditions. There are five municipal and industrial water supply intakes in the Calallen Pool area that have reported chlorides and TDS fluctuations. By using the CCWSM to evaluate the effects of various reservoir operations upon quality of water of the Calallen Pool, overall water quality of the Calallen Pool can be stabilized and the reliability of regional water supplies can be increased which will reduce water consumption and treatment costs. For example, poor raw water quality causes more water to be used in industrial cooling towers; therefore improvements to water quality will directly support industrial water conservation.

The calibrated CCWSM was used to evaluate four reservoir operating scenarios to determine the impacts to reservoir and Calallen Pool water quality, including: 1) variable trigger levels for water delivery from CCR to LCC; 2) safe versus firm yield; 3) constant versus a seasonal monthly delivery pattern from Lake Texana; and 4) monthly variable LCC trigger levels for water delivery from CCR.

For simulations with variable trigger levels for water delivery from CCR to LCC (Scenario 1), the higher trigger level of 86 ft-msl showed lower median chloride levels in CCR. There were no significant impacts to LCC, Calallen Pool, or Lake Texana water quality with variable trigger levels. For the safe versus firm yield evaluation (Scenario 2), median chloride levels increased about 13% and 10% for CCR and Calallen Pool, respectively, with safe yield analyses. For the seasonal versus monthly delivery pattern from Lake Texana (Scenario 3), no significant changes were reported to CCR, LCC, Calallen Pool, or Lake Texana water quality. With monthly variable LCC trigger levels in the summer (83 ft-msl) as compared to a constant LCC trigger level at 74 ft-msl (Scenario 4), median chloride levels decreased about 5% in CCR.

Region N-Specific Water Conservation Best Management Practices (Study 5)

This study included gathering information for current water conservation programs in the Coastal Bend Region, developing a list of water conservation best management practices (BMPs) to promote to regional water users, distributing a water conservation survey throughout the Coastal Bend Region requesting voluntary feedback, and evaluating survey results. The survey had a response rate of 29% (21 responses out of 72 requests) for rural and urban communities throughout the eleven-county Coastal Bend Region for a range of utility sizes from small water supply corporations to the largest wholesale water provider in the region, the City of Corpus Christi. The completed surveys included system-specific information about voluntary water conservation programs implemented by water users in the Coastal Bend Region, including: the amount of reduction in water consumption, program goals, costs, currently implemented BMPs, interest in additional water conservation BMPs, and challenges in implementing future water conservation measures.

According to survey responses, the primary objectives of water conservation programs in the Coastal Bend Region are to reduce: 1) unaccounted for water; 2) per capita consumption; and/or 3) seasonal and peak water demands. The main reasons cited for a lack of interest in adding new BMPs to existing water conservation programs are cost and a lack of staff. In the future, the Texas Legislature should continue to provide funding to the TWDB and other state agencies for water conservation initiatives, including providing technical support and assistance to water user groups regarding public information programs; adoption of conservation rates; tracking the effectiveness of implemented BMPs; leak detection, repair, and monitoring; meter testing and replacement; or other BMPs included in their water conservation programs. Additional water conservation grants or low-interest loans may also provide needed assistance for water user groups that may be interested in implementing voluntary BMPs in the future.

Appendix A

DB22 Reports

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Region N Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
ARANSAS PASS	927	948	946	952	952	952
ROCKPORT	19,120	19,533	19,491	19,620	19,622	19,622
COUNTY-OTHER	4,416	4,510	4,500	4,530	4,529	4,530
SAN ANTONIO-NUECES BASIN TOTAL	**24,463**	**24,991**	**24,937**	**25,102**	**25,103**	**25,104**
ARANSAS COUNTY TOTAL	**24,463**	**24,991**	**24,937**	**25,102**	**25,103**	**25,104**
EL OSO WSC*	433	452	459	461	461	461
COUNTY-OTHER	14	15	15	15	15	15
NUECES BASIN TOTAL	**447**	**467**	**474**	**476**	**476**	**476**
BEEVILLE	15,418	16,063	16,343	16,369	16,385	16,391
EL OSO WSC*	30	31	32	32	32	32
PETTUS MUD	700	729	742	743	744	744
TDCJ CHASE FIELD	3,425	3,568	3,631	3,637	3,640	3,641
COUNTY-OTHER	13,458	14,021	14,265	14,288	14,302	14,306
SAN ANTONIO-NUECES BASIN TOTAL	**33,031**	**34,412**	**35,013**	**35,069**	**35,103**	**35,114**
BEE COUNTY TOTAL	**33,478**	**34,879**	**35,487**	**35,545**	**35,579**	**35,590**
FALFURRIAS	6,018	6,238	6,452	6,646	6,826	7,064
COUNTY-OTHER	1,765	2,014	2,270	2,535	2,769	2,915
NUECES-RIO GRANDE BASIN TOTAL	**7,783**	**8,252**	**8,722**	**9,181**	**9,595**	**9,979**
BROOKS COUNTY TOTAL	**7,783**	**8,252**	**8,722**	**9,181**	**9,595**	**9,979**
FREER WCID	3,041	3,221	3,370	3,502	3,605	3,691
COUNTY-OTHER	307	324	337	348	356	362
NUECES BASIN TOTAL	**3,348**	**3,545**	**3,707**	**3,850**	**3,961**	**4,053**
DUVAL COUNTY CRD	1,859	1,971	2,062	2,142	2,206	2,258
SAN DIEGO MUD 1	4,044	4,304	4,524	4,725	4,892	5,034
COUNTY-OTHER	3,464	3,650	3,805	3,927	4,021	4,090
NUECES-RIO GRANDE BASIN TOTAL	**9,367**	**9,925**	**10,391**	**10,794**	**11,119**	**11,382**
DUVAL COUNTY TOTAL	**12,715**	**13,470**	**14,098**	**14,644**	**15,080**	**15,435**
COUNTY-OTHER	2,908	3,151	3,372	3,602	3,805	3,991
NUECES BASIN TOTAL	**2,908**	**3,151**	**3,372**	**3,602**	**3,805**	**3,991**
ALICE	22,566	24,424	26,110	27,856	29,395	30,804
JIM WELLS COUNTY FWSD 1	1,943	2,102	2,248	2,398	2,531	2,653
ORANGE GROVE	1,838	1,990	2,127	2,270	2,396	2,510
PREMONT	2,923	3,164	3,382	3,608	3,807	3,990
SAN DIEGO MUD 1	942	1,002	1,054	1,101	1,140	1,173
COUNTY-OTHER	11,867	12,857	13,759	14,698	15,526	16,289
NUECES-RIO GRANDE BASIN TOTAL	**42,079**	**45,539**	**48,680**	**51,931**	**54,795**	**57,419**
JIM WELLS COUNTY TOTAL	**44,987**	**48,690**	**52,052**	**55,533**	**58,600**	**61,410**
COUNTY-OTHER	463	498	504	507	508	508
NUECES-RIO GRANDE BASIN TOTAL	**463**	**498**	**504**	**507**	**508**	**508**
KENEDY COUNTY TOTAL	**463**	**498**	**504**	**507**	**508**	**508**
BAFFIN BAY WSC	1,440	1,579	1,709	1,834	1,953	2,064
KINGSVILLE	28,892	31,651	34,282	36,817	39,194	41,419
NAVAL AIR STATION KINGSVILLE	53	59	63	68	72	76
RICARDO WSC	2,919	3,198	3,464	3,720	3,960	4,185
RIVIERA WATER SYSTEM	736	807	874	938	999	1,056
COUNTY-OTHER	1,527	1,669	1,810	1,947	2,073	2,189

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region N Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
NUECES-RIO GRANDE BASIN TOTAL	**35,567**	**38,963**	**42,202**	**45,324**	**48,251**	**50,989**
KLEBERG COUNTY TOTAL	**35,567**	**38,963**	**42,202**	**45,324**	**48,251**	**50,989**
EL OSO WSC*	827	827	827	827	827	827
GEORGE WEST	2,374	2,375	2,375	2,375	2,375	2,375
MCCOY WSC*	170	170	170	170	170	170
THREE RIVERS	3,146	3,148	3,148	3,148	3,148	3,148
COUNTY-OTHER	5,166	5,170	5,170	5,170	5,170	5,170
NUECES BASIN TOTAL	**11,683**	**11,690**	**11,690**	**11,690**	**11,690**	**11,690**
LIVE OAK COUNTY TOTAL	**11,683**	**11,690**	**11,690**	**11,690**	**11,690**	**11,690**
COUNTY-OTHER	734	734	734	734	734	734
NUECES BASIN TOTAL	**734**	**734**	**734**	**734**	**734**	**734**
MCMULLEN COUNTY TOTAL	**734**	**734**	**734**	**734**	**734**	**734**
CORPUS CHRISTI	25,232	27,483	28,898	29,726	30,342	30,755
NUECES COUNTY WCID 3	3,277	3,316	3,316	3,316	3,316	3,316
NUECES WSC	72	94	108	124	142	163
RIVER ACRES WSC	2,662	2,899	3,049	3,137	3,201	3,245
COUNTY-OTHER	744	840	907	928	927	905
NUECES BASIN TOTAL	**31,987**	**34,632**	**36,278**	**37,231**	**37,928**	**38,384**
BISHOP	3,446	3,754	3,947	4,060	4,144	4,201
CORPUS CHRISTI	306,770	334,135	351,336	361,408	368,902	373,919
CORPUS CHRISTI NAVAL AIR STATION	707	770	810	833	850	862
DRISCOLL	812	885	930	957	977	990
NUECES COUNTY WCID 3	10,317	10,440	10,440	10,440	10,440	10,440
NUECES COUNTY WCID 4	4,846	5,277	5,549	5,708	5,827	5,905
NUECES WSC	2,641	3,465	3,971	4,552	5,218	5,981
VIOLET WSC	2,142	2,333	2,453	2,523	2,576	2,610
COUNTY-OTHER	10,474	11,827	12,781	13,067	13,056	12,746
NUECES-RIO GRANDE BASIN TOTAL	**342,155**	**372,886**	**392,217**	**403,548**	**411,990**	**417,654**
ARANSAS PASS	11	12	13	13	13	13
COUNTY-OTHER	4	4	5	5	5	5
SAN ANTONIO-NUECES BASIN TOTAL	**15**	**16**	**18**	**18**	**18**	**18**
NUECES COUNTY TOTAL	**374,157**	**407,534**	**428,513**	**440,797**	**449,936**	**456,056**
MATHIS	5,114	5,364	5,507	5,611	5,683	5,730
COUNTY-OTHER	4,004	4,196	4,310	4,395	4,447	4,486
NUECES BASIN TOTAL	**9,118**	**9,560**	**9,817**	**10,006**	**10,130**	**10,216**
ARANSAS PASS	9,603	10,073	10,342	10,538	10,672	10,761
GREGORY	2,024	2,123	2,179	2,221	2,249	2,268
INGLESIDE	9,610	10,078	10,348	10,545	10,678	10,768
ODEM	2,647	2,777	2,852	2,905	2,942	2,967
PORTLAND	20,646	21,654	22,233	22,655	22,941	23,136
RINCON WSC	3,660	3,839	3,942	4,016	4,068	4,101
SINTON	5,738	6,019	6,179	6,296	6,377	6,430
TAFT	3,768	3,951	4,057	4,133	4,186	4,221
COUNTY-OTHER	1,946	2,040	2,094	2,136	2,162	2,181
SAN ANTONIO-NUECES BASIN TOTAL	**59,642**	**62,554**	**64,226**	**65,445**	**66,275**	**66,833**
SAN PATRICIO COUNTY TOTAL	**68,760**	**72,114**	**74,043**	**75,451**	**76,405**	**77,049**
REGION N POPULATION TOTAL	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**

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Region N Water User Group (WUG) Population

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Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARANSAS PASS	132	131	127	126	126	126
ROCKPORT	3,462	3,469	3,410	3,404	3,398	3,398
COUNTY-OTHER	491	480	462	457	455	455
MINING	10	7	5	5	5	5
LIVESTOCK	56	56	56	56	56	56
SAN ANTONIO-NUECES BASIN TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
ARANSAS COUNTY TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
EL OSO WSC*	94	94	94	94	90	90
COUNTY-OTHER	2	2	2	2	2	2
MINING	57	55	52	45	41	38
LIVESTOCK	80	80	80	80	80	80
IRRIGATION	220	220	220	220	220	220
NUECES BASIN TOTAL	**453**	**451**	**448**	**441**	**433**	**430**
BEEVILLE	3,336	3,397	3,394	3,377	3,375	3,376
EL OSO WSC*	6	7	7	7	6	6
PETTUS MUD	104	105	104	103	103	103
TDCJ CHASE FIELD	1,024	1,050	1,055	1,051	1,050	1,050
COUNTY-OTHER	1,873	1,898	1,891	1,872	1,870	1,870
MINING	415	403	376	327	297	280
LIVESTOCK	754	754	754	754	754	754
IRRIGATION	4,205	4,205	4,205	4,205	4,205	4,205
SAN ANTONIO-NUECES BASIN TOTAL	**11,717**	**11,819**	**11,786**	**11,696**	**11,660**	**11,644**
BEE COUNTY TOTAL	**12,170**	**12,270**	**12,234**	**12,137**	**12,093**	**12,074**
FALFURRIAS	1,639	1,668	1,703	1,745	1,790	1,852
COUNTY-OTHER	224	246	269	297	324	341
MANUFACTURING	1	1	1	1	1	1
MINING	357	360	340	324	308	298
LIVESTOCK	463	463	463	463	463	463
IRRIGATION	1,161	1,161	1,161	1,161	1,161	1,161
NUECES-RIO GRANDE BASIN TOTAL	**3,845**	**3,899**	**3,937**	**3,991**	**4,047**	**4,116**
BROOKS COUNTY TOTAL	**3,845**	**3,899**	**3,937**	**3,991**	**4,047**	**4,116**
FREER WCID	687	712	733	755	776	794
COUNTY-OTHER	39	39	40	40	41	42
MINING	125	130	122	112	105	99
LIVESTOCK	94	94	94	94	94	94
IRRIGATION	202	202	202	202	202	202
NUECES BASIN TOTAL	**1,147**	**1,177**	**1,191**	**1,203**	**1,218**	**1,231**
DUVAL COUNTY CRD	260	266	271	277	285	291
SAN DIEGO MUD 1	747	774	797	824	851	876
COUNTY-OTHER	438	445	450	457	467	474
MINING	1,263	1,314	1,230	1,129	1,060	1,005
LIVESTOCK	546	546	546	546	546	546
IRRIGATION	3,840	3,840	3,840	3,840	3,840	3,840
NUECES-RIO GRANDE BASIN TOTAL	**7,094**	**7,185**	**7,134**	**7,073**	**7,049**	**7,032**
DUVAL COUNTY TOTAL	**8,241**	**8,362**	**8,325**	**8,276**	**8,267**	**8,263**
COUNTY-OTHER	412	433	453	479	504	529
MINING	4	4	3	2	1	1

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Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LIVESTOCK	148	148	148	148	148	148
IRRIGATION	354	354	354	354	354	354
NUECES BASIN TOTAL	**918**	**939**	**958**	**983**	**1,007**	**1,032**
ALICE	4,494	4,744	4,978	5,267	5,548	5,812
JIM WELLS COUNTY FWSD 1	131	141	151	161	170	178
ORANGE GROVE	476	506	534	566	596	625
PREMONT	709	752	791	841	886	928
SAN DIEGO MUD 1	174	180	186	192	198	204
COUNTY-OTHER	1,683	1,768	1,850	1,953	2,058	2,158
MANUFACTURING	79	95	95	95	95	95
MINING	67	70	52	38	25	16
LIVESTOCK	754	754	754	754	754	754
IRRIGATION	1,559	1,559	1,559	1,559	1,559	1,559
NUECES-RIO GRANDE BASIN TOTAL	**10,126**	**10,569**	**10,950**	**11,426**	**11,889**	**12,329**
JIM WELLS COUNTY TOTAL	**11,044**	**11,508**	**11,908**	**12,409**	**12,896**	**13,361**
COUNTY-OTHER	244	260	262	263	263	263
MINING	118	123	92	68	43	27
LIVESTOCK	735	735	735	735	735	735
NUECES-RIO GRANDE BASIN TOTAL	**1,097**	**1,118**	**1,089**	**1,066**	**1,041**	**1,025**
KENEDY COUNTY TOTAL	**1,097**	**1,118**	**1,089**	**1,066**	**1,041**	**1,025**
BAFFIN BAY WSC	237	253	268	285	303	320
KINGSVILLE	4,205	4,453	4,706	4,992	5,301	5,599
NAVAL AIR STATION KINGSVILLE	256	284	303	327	347	366
RICARDO WSC	340	361	382	405	430	454
RIVIERA WATER SYSTEM	114	121	129	137	145	153
COUNTY-OTHER	257	272	290	311	331	349
MANUFACTURING	1,809	2,056	2,056	2,056	2,056	2,056
MINING	357	360	340	324	308	298
LIVESTOCK	673	673	673	673	673	673
IRRIGATION	850	850	850	850	850	850
NUECES-RIO GRANDE BASIN TOTAL	**9,098**	**9,683**	**9,997**	**10,360**	**10,744**	**11,118**
KLEBERG COUNTY TOTAL	**9,098**	**9,683**	**9,997**	**10,360**	**10,744**	**11,118**
EL OSO WSC*	178	174	171	169	160	160
GEORGE WEST	435	424	414	411	410	410
MCCOY WSC*	21	20	20	20	20	20
THREE RIVERS	545	530	518	512	511	511
COUNTY-OTHER	637	622	610	604	602	602
MANUFACTURING	2,274	2,493	2,493	2,493	2,493	2,493
MINING	814	917	907	729	492	332
LIVESTOCK	740	740	740	740	740	740
IRRIGATION	1,630	1,630	1,630	1,630	1,630	1,630
NUECES BASIN TOTAL	**7,274**	**7,550**	**7,503**	**7,308**	**7,058**	**6,898**
LIVE OAK COUNTY TOTAL	**7,274**	**7,550**	**7,503**	**7,308**	**7,058**	**6,898**
COUNTY-OTHER	97	94	91	89	89	89
MANUFACTURING	219	249	249	249	249	249
MINING	4,268	4,804	4,754	2,622	1,850	1,305
LIVESTOCK	335	335	335	335	335	335

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Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
NUECES BASIN TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
MCMULLEN COUNTY TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
CORPUS CHRISTI	4,872	5,182	5,357	5,463	5,568	5,642
NUECES COUNTY WCID 3	965	962	953	948	947	947
NUECES WSC	12	16	18	20	23	26
RIVER ACRES WSC	426	450	462	470	479	485
COUNTY-OTHER	98	106	112	113	113	110
MANUFACTURING	657	728	728	728	728	728
MINING	644	759	842	908	1,005	1,121
STEAM ELECTRIC POWER	1,670	1,670	1,670	1,670	1,670	1,670
LIVESTOCK	50	50	50	50	50	50
IRRIGATION	51	51	51	51	51	51
NUECES BASIN TOTAL	**9,445**	**9,974**	**10,243**	**10,421**	**10,634**	**10,830**
BISHOP	593	627	645	660	672	681
CORPUS CHRISTI	59,238	62,998	65,136	66,425	67,690	68,598
CORPUS CHRISTI NAVAL AIR STATION	1,085	1,178	1,237	1,271	1,296	1,315
DRISCOLL	105	110	112	114	116	117
NUECES COUNTY WCID 3	3,039	3,030	2,999	2,985	2,982	2,981
NUECES COUNTY WCID 4	2,465	2,661	2,782	2,854	2,912	2,951
NUECES WSC	445	573	650	742	848	973
VIOLET WSC	186	193	196	198	201	204
COUNTY-OTHER	1,376	1,497	1,582	1,599	1,594	1,556
MANUFACTURING	44,754	49,635	49,635	49,635	49,635	49,635
MINING	51	60	67	72	80	89
STEAM ELECTRIC POWER	407	407	407	407	407	407
LIVESTOCK	241	241	241	241	241	241
IRRIGATION	1,489	1,489	1,489	1,489	1,489	1,489
NUECES-RIO GRANDE BASIN TOTAL	**115,474**	**124,699**	**127,178**	**128,692**	**130,163**	**131,237**
ARANSAS PASS	2	2	2	2	2	2
COUNTY-OTHER	1	1	1	1	1	1
MINING	29	34	38	41	45	50
SAN ANTONIO-NUECES BASIN TOTAL	**32**	**37**	**41**	**44**	**48**	**53**
NUECES COUNTY TOTAL	**124,951**	**134,710**	**137,462**	**139,157**	**140,845**	**142,120**
MATHIS	653	658	655	661	668	673
COUNTY-OTHER	567	576	590	600	606	611
MANUFACTURING	24,323	27,067	27,067	27,067	27,067	27,067
MINING	78	88	92	96	103	112
LIVESTOCK	200	200	200	200	200	200
IRRIGATION	1,464	1,464	1,464	1,464	1,464	1,464
NUECES BASIN TOTAL	**27,285**	**30,053**	**30,068**	**30,088**	**30,108**	**30,127**
ARANSAS PASS	1,370	1,391	1,392	1,399	1,414	1,425
GREGORY	339	344	348	354	357	360
INGLESIDE	1,013	1,024	1,023	1,026	1,036	1,044
ODEM	395	401	401	404	408	411
PORTLAND	3,389	3,458	3,477	3,503	3,539	3,569
RINCON WSC	368	377	381	385	389	392
SINTON	1,345	1,382	1,396	1,411	1,427	1,438

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Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TAFT	540	546	545	552	558	563
COUNTY-OTHER	276	280	287	292	294	297
MANUFACTURING	14,518	16,156	16,156	16,156	16,156	16,156
MINING	294	333	348	364	389	421
STEAM ELECTRIC POWER	1,919	1,919	1,919	1,919	1,919	1,919
LIVESTOCK	196	196	196	196	196	196
IRRIGATION	13,181	13,181	13,181	13,181	13,181	13,181
SAN ANTONIO-NUECES BASIN TOTAL	**39,143**	**40,988**	**41,050**	**41,142**	**41,263**	**41,372**
SAN PATRICIO COUNTY TOTAL	**66,428**	**71,041**	**71,118**	**71,230**	**71,371**	**71,499**
REGION N DEMAND TOTAL	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**

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Region N Water User Group (WUG) Category Summary

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	551,529	594,295	622,344	641,676	657,076	669,122
DEMAND (acre-feet per year)	106,651	112,179	115,413	117,895	120,407	122,499
EXISTING SUPPLIES (acre-feet per year)	102,045	107,508	110,742	113,212	115,696	117,759
NEEDS (acre-feet per year)*	4,606	4,671	4,671	4,683	4,711	4,740

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	63,261	67,520	70,638	72,832	74,405	75,422
DEMAND (acre-feet per year)	8,715	9,019	9,242	9,429	9,614	9,749
EXISTING SUPPLIES (acre-feet per year)	3,086	3,119	3,145	3,181	3,218	3,256
NEEDS (acre-feet per year)*	5,629	5,900	6,098	6,248	6,396	6,493

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	88,634	98,480	98,480	98,480	98,480	98,480
EXISTING SUPPLIES (acre-feet per year)	88,824	82,046	76,971	72,739	68,258	64,039
NEEDS (acre-feet per year)*	1,479	16,617	21,509	25,741	30,222	34,441

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	8,951	9,821	9,660	7,206	6,157	5,497
EXISTING SUPPLIES (acre-feet per year)	6,748	7,391	7,333	5,021	3,999	3,281
NEEDS (acre-feet per year)*	2,203	2,430	2,327	2,185	2,158	2,216

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	3,996	3,996	3,996	3,996	3,996	3,996
EXISTING SUPPLIES (acre-feet per year)	3,996	3,996	3,996	3,996	3,996	3,996
NEEDS (acre-feet per year)*	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	6,065	6,065	6,065	6,065	6,065	6,065
EXISTING SUPPLIES (acre-feet per year)	6,065	6,065	6,065	6,065	6,065	6,065
NEEDS (acre-feet per year)*	0	0	0	0	0	0

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	30,206	30,206	30,206	30,206	30,206	30,206
EXISTING SUPPLIES (acre-feet per year)	28,923	28,732	28,732	28,732	28,732	28,732
NEEDS (acre-feet per year)*	1,283	1,474	1,474	1,474	1,474	1,474

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CARRIZO-WILCOX AQUIFER	MCMULLEN	NUECES	FRESH	7,056	7,056	4,405	4,405	4,405	4,405
GULF COAST AQUIFER SYSTEM	ARANSAS	SAN ANTONIO-NUECES	FRESH	1,542	1,542	1,542	1,542	1,542	1,542
GULF COAST AQUIFER SYSTEM	BEE	NUECES	FRESH	797	920	976	1,005	1,022	1,022
GULF COAST AQUIFER SYSTEM	BEE	SAN ANTONIO-NUECES	FRESH/BRACKISH	17,640	18,917	19,526	19,776	19,951	19,951
GULF COAST AQUIFER SYSTEM	BROOKS	NUECES-RIO GRANDE	FRESH	5,582	6,352	7,122	7,892	7,892	7,892
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES	FRESH	326	351	376	401	428	428
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES-RIO GRANDE	FRESH	20,245	21,818	23,388	24,962	26,535	26,535
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES	FRESH	593	593	593	593	593	593
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES-RIO GRANDE	FRESH/BRACKISH	8,551	9,090	9,593	10,132	10,424	10,424
GULF COAST AQUIFER SYSTEM	KENEDY	NUECES-RIO GRANDE	FRESH	13,301	18,621	23,941	29,261	29,261	29,261
GULF COAST AQUIFER SYSTEM	KLEBERG	NUECES-RIO GRANDE	FRESH	10,365	13,082	15,800	18,518	18,711	18,711
GULF COAST AQUIFER SYSTEM	LIVE OAK	NUECES	FRESH	8,297	9,297	8,522	8,400	8,400	8,400
GULF COAST AQUIFER SYSTEM	LIVE OAK	SAN ANTONIO-NUECES	FRESH	41	46	42	41	41	41
GULF COAST AQUIFER SYSTEM	MCMULLEN	NUECES	FRESH	510	510	510	510	510	510
GULF COAST AQUIFER SYSTEM	NUECES	NUECES	FRESH	727	756	787	816	845	845
GULF COAST AQUIFER SYSTEM	NUECES	NUECES-RIO GRANDE	FRESH	5,862	6,191	6,522	6,851	7,079	7,079
GULF COAST AQUIFER SYSTEM	NUECES	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	NUECES	FRESH	4,130	4,502	4,874	5,247	5,619	5,619
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH/BRACKISH	39,481	40,514	41,548	42,581	43,615	43,615
QUEEN CITY AQUIFER	MCMULLEN	NUECES	FRESH	134	134	134	134	134	134
SPARTA AQUIFER	MCMULLEN	NUECES	FRESH	89	89	89	89	89	89
GROUNDWATER SOURCE AVAILABILITY TOTAL				**145,269**	**160,381**	**170,290**	**183,156**	**187,096**	**187,096**

REUSE SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DIRECT REUSE	NUECES	NUECES-RIO GRANDE	FRESH	1,213	1,213	1,213	1,213	1,213	1,213
DIRECT REUSE	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	2,688	2,688	2,688	2,688	2,688	2,688
REUSE SOURCE AVAILABILITY TOTAL				**3,901**	**3,901**	**3,901**	**3,901**	**3,901**	**3,901**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	RESERVOIR**	NUECES	FRESH	111,560	109,660	107,460	105,260	103,060	100,560
NUECES LIVESTOCK LOCAL SUPPLY	BEE	NUECES	FRESH	44	44	44	44	44	44
NUECES LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES	FRESH	28	28	28	28	28	28
NUECES LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES	FRESH	33	33	33	33	33	33
NUECES LIVESTOCK LOCAL SUPPLY	LIVE OAK	NUECES	FRESH	211	211	211	211	211	211

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region N Source Availability

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NUECES LIVESTOCK LOCAL SUPPLY	MCMULLEN	NUECES	FRESH	295	295	295	295	295	295
NUECES LIVESTOCK LOCAL SUPPLY	NUECES	NUECES	FRESH	50	50	50	50	50	50
NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	NUECES	FRESH	83	83	83	83	83	83
NUECES RUN-OF-RIVER	LIVE OAK	NUECES	FRESH	1,500	1,500	1,500	1,500	1,500	1,500
NUECES RUN-OF-RIVER	NUECES	NUECES	FRESH	384	384	384	384	384	384
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	BROOKS	NUECES-RIO GRANDE	FRESH	125	125	125	125	125	125
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES-RIO GRANDE	FRESH	179	179	179	179	179	179
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	NUECES	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE RUN-OF-RIVER	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	ARANSAS	SAN ANTONIO-NUECES	FRESH	33	33	33	33	33	33
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	BEE	SAN ANTONIO-NUECES	FRESH	420	420	420	420	420	420
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	80	80	80	80	80	80
SAN ANTONIO-NUECES RUN-OF-RIVER	BEE	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SURFACE WATER SOURCE AVAILABILITY TOTAL				**115,029**	**113,129**	**110,929**	**108,729**	**106,529**	**104,029**

REGION N SOURCE AVAILABILITY TOTAL	**264,199**	**277,411**	**285,120**	**295,786**	**297,526**	**295,026**

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	66	65	64	63	63	63
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	66	66	63	63	63	63
ROCKPORT	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,731	1,735	1,705	1,702	1,699	1,699
ROCKPORT	P	TEXANA LAKE/RESERVOIR	1,731	1,734	1,705	1,702	1,699	1,699
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	60	59	57	56	56	56
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	371	362	349	345	343	343
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	60	59	56	56	56	56
MINING	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	10	7	5	5	5	5
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	23	23	23	23	23	23
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	33	33	33	33	33	33
		SAN ANTONIO-NUECES BASIN TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
		ARANSAS COUNTY TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
EL OSO WSC*		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	2	2	2	2	2	2
MINING	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	57	55	52	45	41	38
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	80	80	80	80	80	80
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	220	220	220	220	220	220
		NUECES BASIN TOTAL	**359**	**357**	**354**	**347**	**343**	**340**
BEEVILLE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,925	1,986	1,983	1,966	1,964	1,965
BEEVILLE	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	1,411	1,411	1,411	1,411	1,411	1,411
EL OSO WSC*	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	6	7	7	7	6	6
PETTUS MUD	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	104	105	104	103	103	103
TDCJ CHASE FIELD	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	847	847	847	847	847	847
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	216	216	216	216	216	216
MINING	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	218	218	218	218	218	218
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	754	754	754	754	754	754
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	3,853	3,853	3,853	3,853	3,853	3,853
IRRIGATION	N	SAN ANTONIO-NUECES RUN-OF-RIVER	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**9,334**	**9,397**	**9,393**	**9,375**	**9,372**	**9,373**
		BEE COUNTY TOTAL	**9,693**	**9,754**	**9,747**	**9,722**	**9,715**	**9,713**
FALFURRIAS	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1,639	1,668	1,703	1,745	1,790	1,852
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	32	32	32	32	32	32
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1	1	1	1	1	1
MINING	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	178	178	178	178	178	178
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	338	338	338	338	338	338
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	125	125	125	125	125	125
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1,161	1,161	1,161	1,161	1,161	1,161
		NUECES-RIO GRANDE BASIN TOTAL	**3,474**	**3,503**	**3,538**	**3,580**	**3,625**	**3,687**
		BROOKS COUNTY TOTAL	**3,474**	**3,503**	**3,538**	**3,580**	**3,625**	**3,687**
FREER WCID	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	687	712	733	755	776	794
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	28	28	28	28	28	28
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	94	94	94	94	94	94
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	202	202	202	202	202	202
		NUECES BASIN TOTAL	**1,011**	**1,036**	**1,057**	**1,079**	**1,100**	**1,118**

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DUVAL COUNTY CRD	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	260	266	271	277	285	291
SAN DIEGO MUD 1	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	459	459	459	459	459	459
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	648	648	648	648	648	648
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	544	544	544	544	544	544
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	2	2	2	2	2	2
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	3,840	3,840	3,840	3,840	3,840	3,840
		NUECES-RIO GRANDE BASIN TOTAL	**5,753**	**5,759**	**5,764**	**5,770**	**5,778**	**5,784**
		DUVAL COUNTY TOTAL	**6,764**	**6,795**	**6,821**	**6,849**	**6,878**	**6,902**
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	0	0	0	0	0	0
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	115	115	115	115	115	115
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	33	33	33	33	33	33
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	315	315	315	315	315	315
		NUECES BASIN TOTAL	**463**	**463**	**463**	**463**	**463**	**463**
ALICE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	2,247	2,372	2,489	2,634	2,774	2,906
ALICE	P	TEXANA LAKE/RESERVOIR	2,247	2,372	2,489	2,633	2,774	2,906
JIM WELLS COUNTY FWSD 1	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	131	141	151	161	170	178
ORANGE GROVE	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	476	506	534	566	596	625
PREMONT	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	709	752	791	841	886	928
SAN DIEGO MUD 1	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	174	180	186	192	198	204
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	37	37	37	37	37	37
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	79	79	79	79	79	79
MINING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	19	19	19	19	19	16
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	575	575	575	575	575	575
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	179	179	179	179	179	179
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	1,265	1,265	1,265	1,265	1,265	1,265
		NUECES-RIO GRANDE BASIN TOTAL	**8,138**	**8,477**	**8,794**	**9,181**	**9,552**	**9,898**
		JIM WELLS COUNTY TOTAL	**8,601**	**8,940**	**9,257**	**9,644**	**10,015**	**10,361**
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	244	260	262	263	263	263
MINING	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	60	60	60	60	43	27
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	735	735	735	735	735	735
		NUECES-RIO GRANDE BASIN TOTAL	**1,039**	**1,055**	**1,057**	**1,058**	**1,041**	**1,025**
		KENEDY COUNTY TOTAL	**1,039**	**1,055**	**1,057**	**1,058**	**1,041**	**1,025**
BAFFIN BAY WSC	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	237	253	268	285	303	320
KINGSVILLE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	211	252	268	289	438	518
KINGSVILLE	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	3,781	3,946	4,168	4,415	4,424	4,561
KINGSVILLE	P	TEXANA LAKE/RESERVOIR	213	255	270	288	439	520
NAVAL AIR STATION KINGSVILLE	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	256	284	303	327	347	366
RICARDO WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	170	180	191	202	215	227
RICARDO WSC	P	TEXANA LAKE/RESERVOIR	170	181	191	203	215	227
RIVIERA WATER SYSTEM	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	114	121	129	137	145	153
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	20	21	22	24	25	26
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	218	231	247	264	281	297
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	19	20	22	23	25	26

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Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	1,809	1,809	1,809	1,809	1,809	1,809
MINING	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	218	218	218	218	218	218
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	673	673	673	673	673	673
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	850	850	850	850	850	850
		NUECES-RIO GRANDE BASIN TOTAL	**8,959**	**9,294**	**9,629**	**10,007**	**10,407**	**10,791**
		KLEBERG COUNTY TOTAL	**8,959**	**9,294**	**9,629**	**10,007**	**10,407**	**10,791**
EL OSO WSC*	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	177	173	170	168	158	159
GEORGE WEST	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	435	424	414	411	410	410
MCCOY WSC*	L	QUEEN CITY AQUIFER | ATASCOSA COUNTY	21	20	20	20	20	20
THREE RIVERS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	545	530	518	512	511	511
THREE RIVERS	N	NUECES RUN-OF-RIVER	0	0	0	0	0	0
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	637	622	610	604	602	602
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	965	965	965	965	965	965
MANUFACTURING	N	NUECES RUN-OF-RIVER	1,309	1,500	1,500	1,500	1,500	1,500
MINING	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	814	917	907	729	492	332
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	529	529	529	529	529	529
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	211	211	211	211	211	211
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	1,096	1,096	1,096	1,096	1,096	1,096
IRRIGATION	N	NUECES RUN-OF-RIVER	191	0	0	0	0	0
		NUECES BASIN TOTAL	**6,930**	**6,987**	**6,940**	**6,745**	**6,494**	**6,335**
		LIVE OAK COUNTY TOTAL	**6,930**	**6,987**	**6,940**	**6,745**	**6,494**	**6,335**
COUNTY-OTHER	N	CARRIZO-WILCOX AQUIFER | MCMULLEN COUNTY	97	94	91	89	89	89
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	219	249	249	249	249	249
MINING	N	CARRIZO-WILCOX AQUIFER | MCMULLEN COUNTY	3,810	4,376	4,310	2,178	1,406	861
MINING	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	235	205	221	221	221	221
MINING	N	QUEEN CITY AQUIFER | MCMULLEN COUNTY	134	134	134	134	134	134
MINING	N	SPARTA AQUIFER | MCMULLEN COUNTY	89	89	89	89	89	89
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	56	56	40	40	40	40
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	279	279	295	295	295	295
		NUECES BASIN TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
		MCMULLEN COUNTY TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
CORPUS CHRISTI	K	COLORADO RUN-OF-RIVER	328	426	517	608	802	1,094
CORPUS CHRISTI	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	3,702	3,692	3,666	3,702	3,644	3,451
CORPUS CHRISTI	P	TEXANA LAKE/RESERVOIR	842	1,064	1,174	1,153	1,122	1,097
NUECES COUNTY WCID 3		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
NUECES WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	6	8	9	10	11	13
NUECES WSC	P	TEXANA LAKE/RESERVOIR	6	8	9	10	12	13
RIVER ACRES WSC	N	NUECES RUN-OF-RIVER	192	192	192	192	192	192
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	49	53	56	57	57	55
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	49	53	56	56	56	55
MANUFACTURING	K	COLORADO RUN-OF-RIVER	0	0	0	0	45	45
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	0	45	45	45	0	0
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	657	683	683	683	683	683
MINING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	44	44	44	44	44	44
STEAM ELECTRIC POWER	K	COLORADO RUN-OF-RIVER	557	557	557	557	557	557

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Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	556	556	556	556	556	556
STEAM ELECTRIC POWER	P	TEXANA LAKE/RESERVOIR	557	557	557	557	557	557
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	50	50	50	50	50	50
IRRIGATION		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		NUECES BASIN TOTAL	**7,595**	**7,988**	**8,171**	**8,280**	**8,388**	**8,462**
BISHOP	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	196	219	225	229	231	232
BISHOP	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	282	282	282	282	282	282
BISHOP	P	TEXANA LAKE/RESERVOIR	115	126	138	149	159	167
CORPUS CHRISTI	K	COLORADO RUN-OF-RIVER	3,980	5,182	6,291	7,400	9,754	13,298
CORPUS CHRISTI	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	45,026	44,879	44,573	45,011	44,300	41,965
CORPUS CHRISTI	P	TEXANA LAKE/RESERVOIR	10,232	12,937	14,272	14,014	13,636	13,335
CORPUS CHRISTI NAVAL AIR STATION	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	543	589	619	636	648	658
CORPUS CHRISTI NAVAL AIR STATION	P	TEXANA LAKE/RESERVOIR	542	589	618	635	648	657
DRISCOLL	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	52	55	56	57	58	59
DRISCOLL	P	TEXANA LAKE/RESERVOIR	53	55	56	57	58	58
NUECES COUNTY WCID 3	N	NUECES RUN-OF-RIVER	192	192	192	192	192	192
NUECES COUNTY WCID 4	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,233	1,331	1,391	1,427	1,456	1,475
NUECES COUNTY WCID 4	P	TEXANA LAKE/RESERVOIR	1,232	1,330	1,391	1,427	1,456	1,476
NUECES WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	223	287	325	371	424	486
NUECES WSC	P	TEXANA LAKE/RESERVOIR	222	286	325	371	424	487
VIOLET WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	93	96	98	99	100	102
VIOLET WSC	P	TEXANA LAKE/RESERVOIR	93	97	98	99	101	102
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	51	56	61	66	73	81
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	31	31	31	31	31	31
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	49	54	60	67	73	80
MANUFACTURING	K	COLORADO RUN-OF-RIVER	30,000	28,700	27,500	26,300	23,707	19,871
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	8,422	8,811	9,118	8,664	9,368	11,845
MANUFACTURING	N	DIRECT REUSE	1,213	1,213	1,213	1,213	1,213	1,213
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	119	119	119	119	119	119
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	5,000	1,708	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	51	60	67	72	80	89
STEAM ELECTRIC POWER	K	COLORADO RUN-OF-RIVER	135	135	135	135	135	135
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	136	136	136	136	136	136
STEAM ELECTRIC POWER	P	TEXANA LAKE/RESERVOIR	136	136	136	136	136	136
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	241	241	241	241	241	241
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	1,489	1,489	1,489	1,489	1,489	1,489
IRRIGATION	N	NUECES-RIO GRANDE RUN-OF-RIVER	0	0	0	0	0	0
		NUECES-RIO GRANDE BASIN TOTAL	**111,382**	**111,421**	**111,256**	**111,125**	**110,728**	**110,497**
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1	1	1	1	1	1
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	1	1	1	1	1	1

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Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	1	1	1	1	1	1
MINING		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**3**	**3**	**3**	**3**	**3**	**3**
		NUECES COUNTY TOTAL	**118,980**	**119,412**	**119,430**	**119,408**	**119,119**	**118,962**
MATHIS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	326	329	327	330	334	336
MATHIS	P	TEXANA LAKE/RESERVOIR	327	329	328	331	334	337
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	330	324	315	307	303	300
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	186	189	193	197	199	200
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	51	63	82	96	104	111
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	22,844	19,825	18,292	16,712	15,124	13,361
MINING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	28	28	28	28	28	28
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	117	117	117	117	117	117
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	83	83	83	83	83	83
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	1,444	1,444	1,444	1,444	1,444	1,444
		NUECES BASIN TOTAL	**25,736**	**22,731**	**21,209**	**19,645**	**18,070**	**16,317**
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	685	696	696	700	707	713
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	685	695	696	699	707	712
GREGORY	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	169	172	174	177	179	180
GREGORY	P	TEXANA LAKE/RESERVOIR	170	172	174	177	178	180
INGLESIDE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	507	512	512	513	518	522
INGLESIDE	P	TEXANA LAKE/RESERVOIR	506	512	511	513	518	522
ODEM	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	205	209	209	210	212	215
ODEM	P	TEXANA LAKE/RESERVOIR	190	192	192	194	196	196
PORTLAND	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	2,073	2,116	2,128	2,144	2,165	2,184
PORTLAND	P	TEXANA LAKE/RESERVOIR	1,316	1,342	1,349	1,359	1,374	1,385
RINCON WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	184	188	190	192	194	196
RINCON WSC	P	TEXANA LAKE/RESERVOIR	184	189	191	193	195	196
SINTON	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	1,345	1,382	1,396	1,411	1,427	1,438
TAFT	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	319	322	322	326	330	332
TAFT	P	TEXANA LAKE/RESERVOIR	221	224	223	226	228	231
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	258	262	269	274	276	279
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	18	18	18	18	18	18
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	11,560	11,833	10,919	9,976	9,028	7,975
MANUFACTURING	N	DIRECT REUSE	448	448	448	448	448	448
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	25	25	25	25	25	25
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	4,154	4,033	4,006	3,951	3,895	3,851
MINING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	107	107	107	107	107	107
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,919	1,919	1,919	1,919	1,919	1,919

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Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	116	116	116	116	116	116
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	80	80	80	80	80	80
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	12,997	12,997	12,997	12,997	12,997	12,997
IRRIGATION	N	SAN ANTONIO-NUECES RUN-OF-RIVER	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**40,441**	**40,761**	**39,867**	**38,945**	**38,037**	**37,017**
		SAN PATRICIO COUNTY TOTAL	**66,177**	**63,492**	**61,076**	**58,590**	**56,107**	**53,334**
		REGION N EXISTING WATER SUPPLY TOTAL	**239,687**	**238,857**	**236,984**	**232,946**	**229,964**	**227,128**

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Region N Water User Group (WUG) Needs/Surplus

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARANSAS COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
ROCKPORT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
BEE COUNTY - NUECES BASIN						
EL OSO WSC*	(94)	(94)	(94)	(94)	(90)	(90)
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
BEE COUNTY - SAN ANTONIO-NUECES BASIN						
BEEVILLE	0	0	0	0	0	0
EL OSO WSC*	0	0	0	0	0	0
PETTUS MUD	0	0	0	0	0	0
TDCJ CHASE FIELD	(177)	(203)	(208)	(204)	(203)	(203)
COUNTY-OTHER	(1,657)	(1,682)	(1,675)	(1,656)	(1,654)	(1,654)
MINING	(197)	(185)	(158)	(109)	(79)	(62)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(352)	(352)	(352)	(352)	(352)	(352)
BROOKS COUNTY - NUECES-RIO GRANDE BASIN						
FALFURRIAS	0	0	0	0	0	0
COUNTY-OTHER	(192)	(214)	(237)	(265)	(292)	(309)
MANUFACTURING	0	0	0	0	0	0
MINING	(179)	(182)	(162)	(146)	(130)	(120)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES BASIN						
FREER WCID	0	0	0	0	0	0
COUNTY-OTHER	(39)	(39)	(40)	(40)	(41)	(42)
MINING	(97)	(102)	(94)	(84)	(77)	(71)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES-RIO GRANDE BASIN						
DUVAL COUNTY CRD	0	0	0	0	0	0
SAN DIEGO MUD 1	(288)	(315)	(338)	(365)	(392)	(417)
COUNTY-OTHER	(438)	(445)	(450)	(457)	(467)	(474)
MINING	(615)	(666)	(582)	(481)	(412)	(357)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JIM WELLS COUNTY - NUECES BASIN						
COUNTY-OTHER	(412)	(433)	(453)	(479)	(504)	(529)
MINING	(4)	(4)	(3)	(2)	(1)	(1)

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Region N Water User Group (WUG) Needs/Surplus

LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(39)	(39)	(39)	(39)	(39)	(39)
JIM WELLS COUNTY - NUECES-RIO GRANDE BASIN						
ALICE	0	0	0	0	0	0
JIM WELLS COUNTY FWSD 1	0	0	0	0	0	0
ORANGE GROVE	0	0	0	0	0	0
PREMONT	0	0	0	0	0	0
SAN DIEGO MUD 1	0	0	0	0	0	0
COUNTY-OTHER	(1,646)	(1,731)	(1,813)	(1,916)	(2,021)	(2,121)
MANUFACTURING	0	(16)	(16)	(16)	(16)	(16)
MINING	(48)	(51)	(33)	(19)	(6)	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(294)	(294)	(294)	(294)	(294)	(294)
KENEDY COUNTY - NUECES-RIO GRANDE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	(58)	(63)	(32)	(8)	0	0
LIVESTOCK	0	0	0	0	0	0
KLEBERG COUNTY - NUECES-RIO GRANDE BASIN						
BAFFIN BAY WSC	0	0	0	0	0	0
KINGSVILLE	0	0	0	0	0	0
NAVAL AIR STATION KINGSVILLE	0	0	0	0	0	0
RICARDO WSC	0	0	0	0	0	0
RIVIERA WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	1	0	0	0
MANUFACTURING	0	(247)	(247)	(247)	(247)	(247)
MINING	(139)	(142)	(122)	(106)	(90)	(80)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LIVE OAK COUNTY - NUECES BASIN						
EL OSO WSC*	(1)	(1)	(1)	(1)	(2)	(1)
GEORGE WEST	0	0	0	0	0	0
MCCOY WSC*	0	0	0	0	0	0
THREE RIVERS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	(28)	(28)	(28)	(28)	(28)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(343)	(534)	(534)	(534)	(534)	(534)
MCMULLEN COUNTY - NUECES BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
NUECES COUNTY - NUECES BASIN						
CORPUS CHRISTI	0	0	0	0	0	0
NUECES COUNTY WCID 3	(965)	(962)	(953)	(948)	(947)	(947)
NUECES WSC	0	0	0	0	0	0
RIVER ACRES WSC	(234)	(258)	(270)	(278)	(287)	(293)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0

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Region N Water User Group (WUG) Needs/Surplus

MINING	(600)	(715)	(798)	(864)	(961)	(1,077)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(51)	(51)	(51)	(51)	(51)	(51)
NUECES COUNTY - NUECES-RIO GRANDE BASIN						
BISHOP	0	0	0	0	0	0
CORPUS CHRISTI	0	0	0	0	0	0
CORPUS CHRISTI NAVAL AIR STATION	0	0	0	0	0	0
DRISCOLL	0	0	0	0	0	0
NUECES COUNTY WCID 3	(2,847)	(2,838)	(2,807)	(2,793)	(2,790)	(2,789)
NUECES COUNTY WCID 4	0	0	0	0	0	0
NUECES WSC	0	0	0	0	0	0
VIOLET WSC	0	0	0	0	0	0
COUNTY-OTHER	(1,245)	(1,356)	(1,430)	(1,435)	(1,417)	(1,364)
MANUFACTURING	0	(9,084)	(11,685)	(13,339)	(15,228)	(16,587)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
NUECES COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	(29)	(34)	(38)	(41)	(45)	(50)
SAN PATRICIOCOUNTY - NUECES BASIN						
MATHIS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	(1,479)	(7,242)	(8,775)	(10,355)	(11,943)	(13,706)
MINING	(50)	(60)	(64)	(68)	(75)	(84)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(20)	(20)	(20)	(20)	(20)	(20)
SAN PATRICIOCOUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
GREGORY	0	0	0	0	0	0
INGLESIDE	0	0	0	0	0	0
ODEM	0	0	0	0	0	0
PORTLAND	0	0	0	0	0	0
RINCON WSC	0	0	0	0	0	0
SINTON	0	0	0	0	0	0
TAFT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	1,669	183	(758)	(1,756)	(2,760)	(3,857)
MINING	(187)	(226)	(241)	(257)	(282)	(314)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(184)	(184)	(184)	(184)	(184)	(184)

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Region N Water User Group (WUG) Second-Tier Identified Water Needs

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARANSAS COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
ROCKPORT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
BEE COUNTY - NUECES BASIN						
EL OSO WSC*	92	86	81	79	75	73
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
BEE COUNTY - SAN ANTONIO-NUECES BASIN						
BEEVILLE	0	0	0	0	0	0
EL OSO WSC*	0	0	0	0	0	0
PETTUS MUD	0	0	0	0	0	0
TDCJ CHASE FIELD	177	118	41	0	0	0
COUNTY-OTHER	1,657	1,682	1,675	1,656	1,654	1,654
MINING	188	167	133	80	46	25
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	252	152	53	0	0	0
BROOKS COUNTY - NUECES-RIO GRANDE BASIN						
FALFURRIAS	0	0	0	0	0	0
COUNTY-OTHER	192	214	237	265	292	309
MANUFACTURING	0	0	0	0	0	0
MINING	170	164	136	114	91	75
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES BASIN						
FREER WCID	0	0	0	0	0	0
COUNTY-OTHER	39	39	40	40	41	42
MINING	94	96	85	73	64	56
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES-RIO GRANDE BASIN						
DUVAL COUNTY CRD	0	0	0	0	0	0
SAN DIEGO MUD 1	288	260	250	282	308	330
COUNTY-OTHER	438	445	450	457	467	474
MINING	583	600	490	368	279	206
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JIM WELLS COUNTY - NUECES BASIN						
COUNTY-OTHER	412	433	453	479	504	529
MINING	4	4	3	2	1	1
LIVESTOCK	0	0	0	0	0	0

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Region N Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JIM WELLS COUNTY - NUECES BASIN						
IRRIGATION	30	21	13	4	0	0
JIM WELLS COUNTY - NUECES-RIO GRANDE BASIN						
ALICE	0	0	0	0	0	0
JIM WELLS COUNTY FWSD 1	0	0	0	0	0	0
ORANGE GROVE	0	0	0	0	0	0
PREMONT	0	0	0	0	0	0
SAN DIEGO MUD 1	0	0	0	0	0	0
COUNTY-OTHER	1,646	1,731	1,813	1,916	2,021	2,121
MANUFACTURING	0	11	9	6	4	2
MINING	46	47	29	15	3	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	255	216	177	138	99	60
KENEDY COUNTY - NUECES-RIO GRANDE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	55	57	25	1	0	0
LIVESTOCK	0	0	0	0	0	0
KLEBERG COUNTY - NUECES-RIO GRANDE BASIN						
BAFFIN BAY WSC	0	0	0	0	0	0
KINGSVILLE	0	0	0	0	0	0
NAVAL AIR STATION KINGSVILLE	0	0	0	0	0	0
RICARDO WSC	0	0	0	0	0	0
RIVIERA WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	144	93	41	0	0
MINING	130	124	96	74	51	35
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LIVE OAK COUNTY - NUECES BASIN						
EL OSO WSC*	0	0	0	0	0	0
GEORGE WEST	0	0	0	0	0	0
MCCOY WSC*	0	0	0	0	0	0
THREE RIVERS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	302	452	412	371	330	289
MCMULLEN COUNTY - NUECES BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
NUECES COUNTY - NUECES BASIN						
CORPUS CHRISTI	0	0	0	0	0	0
NUECES COUNTY WCID 3	965	883	799	722	653	591
NUECES WSC	0	0	0	0	0	0
RIVER ACRES WSC	234	258	270	278	287	293

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Region N Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
NUECES COUNTY - NUECES BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	599	713	795	860	956	1,070
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	51	51	51	51	51	51
NUECES COUNTY - NUECES-RIO GRANDE BASIN						
BISHOP	0	0	0	0	0	0
CORPUS CHRISTI	0	0	0	0	0	0
CORPUS CHRISTI NAVAL AIR STATION	0	0	0	0	0	0
DRISCOLL	0	0	0	0	0	0
NUECES COUNTY WCID 3	2,847	2,589	2,323	2,083	1,865	1,668
NUECES COUNTY WCID 4	0	0	0	0	0	0
NUECES WSC	0	0	0	0	0	0
VIOLET WSC	0	0	0	0	0	0
COUNTY-OTHER	1,245	1,356	1,430	1,435	1,417	1,364
MANUFACTURING	0	6,602	7,963	8,376	9,024	9,142
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
NUECES COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	29	34	38	41	45	50
SAN PATRICIO COUNTY - NUECES BASIN						
MATHIS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	871	879	1,735	2,638	3,550	4,636
MINING	49	56	59	60	65	71
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
SAN PATRICIO COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
GREGORY	0	0	0	0	0	0
INGLESIDE	0	0	0	0	0	0
ODEM	0	0	0	0	0	0
PORTLAND	0	0	0	0	0	0
RINCON WSC	0	0	0	0	0	0
SINTON	0	0	0	0	0	0
TAFT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	141	740	1,434
MINING	181	213	220	229	243	264
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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Region N Water User Group (WUG) Second-Tier Identified Water Needs

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Region N Water User Group (WUG) Second-Tier Identified Water Needs Summary

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	4,603	4,194	3,764	3,444	3,188	2,955
COUNTY-OTHER	5,629	5,900	6,098	6,248	6,396	6,493
MANUFACTURING	871	7,636	9,800	11,202	13,318	15,214
MINING	2,128	2,275	2,109	1,917	1,844	1,853
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	890	892	706	564	480	400

Region N Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
CARRIZO-WILCOX AQUIFER	MCMULLEN	NUECES	FRESH	3,149	2,586	4	2,138	2,910	3,455
GULF COAST AQUIFER SYSTEM	ARANSAS	SAN ANTONIO-NUECES	FRESH	1,138	1,150	1,165	1,169	1,171	1,171
GULF COAST AQUIFER SYSTEM	BEE	NUECES	FRESH	438	563	622	658	679	682
GULF COAST AQUIFER SYSTEM	BEE	SAN ANTONIO-NUECES	FRESH/BRACKISH	10,231	11,506	12,116	12,367	12,543	12,543
GULF COAST AQUIFER SYSTEM	BROOKS	NUECES-RIO GRANDE	FRESH	2,233	2,974	3,709	4,437	4,392	4,330
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES	FRESH	2	27	52	77	104	104
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES-RIO GRANDE	FRESH	13,633	15,169	16,707	18,247	19,785	19,755
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES	FRESH	163	163	163	163	163	163
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES-RIO GRANDE	FRESH/BRACKISH	5,260	5,716	6,142	6,589	6,797	6,721
GULF COAST AQUIFER SYSTEM	KENEDY	NUECES-RIO GRANDE	FRESH	12,262	17,566	22,884	28,203	28,220	28,236
GULF COAST AQUIFER SYSTEM	KLEBERG	NUECES-RIO GRANDE	FRESH	2,209	4,697	7,135	9,540	9,661	9,464
GULF COAST AQUIFER SYSTEM	LIVE OAK	NUECES	FRESH	3,643	4,570	3,830	3,897	4,146	4,306
GULF COAST AQUIFER SYSTEM	LIVE OAK	SAN ANTONIO-NUECES	FRESH	41	46	42	41	41	41
GULF COAST AQUIFER SYSTEM	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	NUECES	NUECES	FRESH	26	29	60	89	118	118
GULF COAST AQUIFER SYSTEM	NUECES	NUECES-RIO GRANDE	FRESH	3,649	3,969	4,293	4,617	4,837	4,828
GULF COAST AQUIFER SYSTEM	NUECES	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	NUECES	FRESH	2,355	2,724	3,092	3,461	3,831	3,830
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH/BRACKISH	24,873	25,869	26,889	27,907	28,925	28,914
QUEEN CITY AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
SPARTA AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
			GROUNDWATER SOURCE WATER BALANCE TOTAL	**85,305**	**99,324**	**108,905**	**123,600**	**128,323**	**128,661**

REUSE SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
DIRECT REUSE	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
DIRECT REUSE	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	2,240	2,240	2,240	2,240	2,240	2,240
			REUSE SOURCE WATER BALANCE TOTAL	**2,240**	**2,240**	**2,240**	**2,240**	**2,240**	**2,240**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY*	2020	2030	2040	2050	2060	2070
CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	RESERVOIR**	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	BEE	NUECES	FRESH	44	44	44	44	44	44
NUECES LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES	FRESH	28	28	28	28	28	28
NUECES LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	LIVE OAK	NUECES	FRESH	0	0	0	0	0	0

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region N Source Water Balance (Availability - WUG Supply)

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NUECES LIVESTOCK LOCAL SUPPLY	MCMULLEN	NUECES	FRESH	16	16	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	NUECES	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	NUECES	FRESH	0	0	0	0	0	0
NUECES RUN-OF-RIVER	LIVE OAK	NUECES	FRESH	0	0	0	0	0	0
NUECES RUN-OF-RIVER	NUECES	NUECES	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	BROOKS	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	NUECES	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE RUN-OF-RIVER	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	ARANSAS	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	BEE	SAN ANTONIO-NUECES	FRESH	420	420	420	420	420	420
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	BEE	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SURFACE WATER SOURCE WATER BALANCE TOTAL				**510**	**510**	**494**	**494**	**494**	**494**

REGION N SOURCE WATER BALANCE TOTAL	**88,055**	**102,074**	**111,639**	**126,334**	**131,057**	**131,395**

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARANSAS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,446	491	-66.0%	1,342	455	-66.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,446	491	-66.0%	1,342	455	-66.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	44	56	27.3%	44	56	27.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	44	56	27.3%	44	56	27.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	265	0	-100.0%	265	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	137	0	-100.0%	172	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	10	10	0.0%	10	5	-50.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	10	10	0.0%	5	5	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,065	3,594	74.0%	2,025	3,524	74.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,065	3,594	74.0%	2,025	3,524	74.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BEE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,770	218	-92.1%	2,770	218	-92.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,725	1,875	-31.2%	2,721	1,872	-31.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	1,657	100.0%	0	1,654	100.0%
BEE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	8,025	4,073	-49.2%	8,025	4,073	-49.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,751	4,425	-6.9%	7,985	4,425	-44.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	352	100.0%	0	352	100.0%
BEE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	930	834	-10.3%	930	834	-10.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	930	834	-10.3%	930	834	-10.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BEE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1	0	-100.0%	1	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1	0	-100.0%	1	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BEE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	510	275	-46.1%	510	256	-49.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	472	472	0.0%	318	318	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	197	100.0%	0	62	100.0%
BEE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,068	4,293	39.9%	3,103	4,332	39.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,008	4,564	51.7%	3,040	4,625	52.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	271	100.0%	0	293	100.0%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
BROOKS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	450	32	-92.9%	450	32	-92.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	326	224	-31.3%	449	341	-24.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	192	100.0%	0	309	100.0%
BROOKS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,300	1,161	-49.5%	2,300	1,161	-49.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,800	1,161	-35.5%	2,297	1,161	-49.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	620	463	-25.3%	620	463	-25.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	620	463	-25.3%	620	463	-25.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	1	100.0%	0	1	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	1	100.0%	0	1	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	360	178	-50.6%	360	178	-50.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	357	357	0.0%	298	298	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	179	100.0%	0	120	100.0%
BROOKS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,697	1,639	-39.2%	2,697	1,852	-31.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,677	1,639	-2.3%	1,915	1,852	-3.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	650	0	-100.0%	650	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	549	477	-13.1%	610	516	-15.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	477	100.0%	0	516	100.0%
DUVAL COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,900	4,042	3.6%	3,900	4,042	3.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,004	4,042	34.6%	3,834	4,042	5.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	754	640	-15.1%	754	640	-15.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	754	640	-15.1%	754	640	-15.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,656	676	-85.5%	4,656	676	-85.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,388	1,388	0.0%	1,104	1,104	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	712	100.0%	0	428	100.0%
DUVAL COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,024	1,406	-30.5%	2,024	1,544	-23.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,610	1,694	5.2%	1,858	1,961	5.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	288	100.0%	107	417	289.7%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
JIM WELLS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,430	37	-98.9%	3,430	37	-98.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,634	2,095	-20.5%	3,360	2,687	-20.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	2,058	100.0%	0	2,650	100.0%
JIM WELLS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,300	1,580	-52.1%	3,300	1,580	-52.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,500	1,913	-23.5%	3,191	1,913	-40.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	333	100.0%	0	333	100.0%
JIM WELLS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,029	902	-12.3%	1,029	902	-12.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,029	902	-12.3%	1,029	902	-12.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JIM WELLS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	79	100.0%	0	79	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	79	100.0%	0	95	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	16	100.0%
JIM WELLS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	74	19	-74.3%	74	16	-78.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	71	71	0.0%	17	17	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	52	100.0%	0	1	100.0%
JIM WELLS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	7,016	5,984	-14.7%	8,245	7,747	-6.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,464	5,984	9.5%	7,084	7,747	9.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	51	0	-100.0%
KENEDY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	305	244	-20.0%	305	263	-13.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	244	244	0.0%	264	263	-0.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
KENEDY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	644	735	14.1%	644	735	14.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	644	735	14.1%	644	735	14.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
KENEDY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	130	60	-53.8%	130	27	-79.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	118	118	0.0%	27	27	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	58	100.0%	0	0	0.0%
KLEBERG COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,633	257	-92.9%	3,633	349	-90.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	601	257	-57.2%	817	349	-57.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
KLEBERG COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	800	850	6.3%	800	850	6.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	600	850	41.7%	766	850	11.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
KLEBERG COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,276	673	-47.3%	1,276	673	-47.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,276	673	-47.3%	1,276	673	-47.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
KLEBERG COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	1,809	100.0%	0	1,809	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	1,809	100.0%	0	2,056	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	247	100.0%
KLEBERG COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	380	218	-42.6%	380	218	-42.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	357	357	0.0%	298	298	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	139	100.0%	0	80	100.0%
KLEBERG COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,929	5,152	4.5%	6,159	6,892	11.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,573	5,152	12.7%	6,090	6,892	13.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,002	637	-36.4%	1,002	602	-39.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	802	637	-20.6%	758	602	-20.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,900	1,287	-55.6%	2,900	1,096	-62.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,200	1,630	-25.9%	2,808	1,630	-42.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	343	100.0%	0	534	100.0%
LIVE OAK COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	933	740	-20.7%	933	740	-20.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	933	740	-20.7%	933	740	-20.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	5,054	2,274	-55.0%	5,054	2,465	-51.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,024	2,274	12.4%	2,333	2,493	6.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	28	100.0%
LIVE OAK COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	920	814	-11.5%	920	332	-63.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	814	814	0.0%	332	332	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,507	1,178	-53.0%	2,507	1,100	-56.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	944	1,179	24.9%	882	1,101	24.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	1	100.0%	0	1	100.0%
MCMULLEN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	546	97	-82.2%	546	89	-83.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	97	97	0.0%	90	89	-1.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
MCMULLEN COUNTY | IRRIGATION WUG TYPE						
PROJECTED DEMAND TOTAL (acre-feet per year)	40	0	-100.0%	51	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	40	0	-100.0%	51	0	-100.0%
MCMULLEN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	355	335	-5.6%	355	335	-5.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	355	335	-5.6%	355	335	-5.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	219	100.0%	0	249	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	219	100.0%	0	249	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,535	4,268	178.0%	1,535	1,305	-15.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,268	4,268	0.0%	1,305	1,305	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2,733	0	-100.0%	0	0	0.0%
NUECES COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,042	230	-88.7%	2,096	303	-85.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,554	1,475	-5.1%	2,093	1,667	-20.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	1,245	100.0%	0	1,364	100.0%
NUECES COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	701	1,489	112.4%	701	1,489	112.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	439	1,540	250.8%	560	1,540	175.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	51	100.0%	0	51	100.0%
NUECES COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	315	291	-7.6%	315	291	-7.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	315	291	-7.6%	315	291	-7.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
NUECES COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	50,276	45,411	-9.7%	48,166	33,776	-29.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	50,276	45,411	-9.7%	67,769	50,363	-25.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	19,603	16,587	-15.4%
NUECES COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	724	95	-86.9%	1,260	133	-89.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	724	724	0.0%	1,260	1,260	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	629	100.0%	0	1,127	100.0%
NUECES COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	70,034	69,387	-0.9%	80,902	80,893	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	71,617	73,433	2.5%	82,427	84,922	3.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,583	4,046	155.6%	1,525	4,029	164.2%
NUECES COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	15,038	2,077	-86.2%	27,648	2,077	-92.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	15,038	2,077	-86.2%	34,541	2,077	-94.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	6,893	0	-100.0%
SAN PATRICIO COUNTY | COUNTY-OTHER WUG TYPE						

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EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,584	843	-46.8%	1,705	908	-46.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,584	843	-46.8%	1,705	908	-46.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	14,441	14,441	0.0%	14,441	14,441	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	11,085	14,645	32.1%	18,632	14,645	-21.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	204	100.0%	4,191	204	-95.1%
SAN PATRICIO COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	406	396	-2.5%	406	396	-2.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	406	396	-2.5%	406	396	-2.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	33,286	39,031	17.3%	38,462	25,660	-33.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	39,737	38,841	-2.3%	56,991	43,223	-24.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	6,451	1,479	-77.1%	18,529	17,563	-5.2%
SAN PATRICIO COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	565	135	-76.1%	565	135	-76.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	372	372	0.0%	533	533	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	237	100.0%	0	398	100.0%
SAN PATRICIO COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	9,127	9,412	3.1%	9,446	9,875	4.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	8,561	9,412	9.9%	8,980	9,875	10.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	1,919	100.0%	0	1,919	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	1,919	100.0%	0	1,919	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
REGION N						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	278,782	239,687	-14.0%	308,706	227,128	-26.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	261,970	253,218	-3.3%	343,244	276,492	-19.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	10,807	15,200	40.6%	50,950	49,364	-3.1%

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Region N Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARANSAS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	1,862	1,542	-17.2%	1,862	1,542	-17.2%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	21	33	57.1%	21	33	57.1%
BEE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	20,568	18,437	-10.4%	20,492	20,973	2.3%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	464	464	0.0%	464	464	0.0%
BROOKS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	15,595	5,582	-64.2%	15,595	7,892	-49.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	160	125	-21.9%	160	125	-21.9%
DUVAL COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	14,063	20,571	46.3%	14,063	26,963	91.7%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	148	30	-79.7%	148	30	-79.7%
JIM WELLS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	27,886	9,144	-67.2%	27,886	11,017	-60.5%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	402	212	-47.3%	402	212	-47.3%
KENEDY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	51,778	13,301	-74.3%	51,778	29,261	-43.5%
KLEBERG COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	50,701	10,365	-79.6%	50,701	18,711	-63.1%
LIVE OAK COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	13,833	8,338	-39.7%	13,833	8,441	-39.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,752	1,711	-2.3%	1,752	1,711	-2.3%
MCMULLEN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	2,734	7,789	184.9%	2,734	5,138	87.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	262	295	12.6%	262	295	12.6%
NUECES COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	9,009	6,589	-26.9%	9,009	7,924	-12.0%
REUSE AVAILABILITY TOTAL (acre-feet per year)	1,140	1,213	6.4%	1,140	1,213	6.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,991	436	-78.1%	1,991	436	-78.1%
RESERVOIR* COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	150,160	111,560	-25.7%	143,160	100,560	-29.8%
SAN PATRICIO COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	19,013	43,611	129.4%	19,013	49,234	158.9%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,688	2,688	0.0%	2,688	2,688	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	115	163	41.7%	115	163	41.7%
REGION N						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	227,042	145,269	-36.0%	226,966	187,096	-17.6%
REUSE AVAILABILITY TOTAL (acre-feet per year)	3,828	3,901	1.9%	3,828	3,901	1.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	155,475	115,029	-26.0%	148,475	104,029	-29.9%

* Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region N Water User Group (WUG) Unmet Needs

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**

This results of this table are intentionally blank. Not applicable for Region N.

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region N Water User Group (WUG) Unmet Needs Summary

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

No unmet needs in Region N.

Region N Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
ALICE	N	CITY OF ALICE - GROUNDWATER DESALINATION	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | JIM WELLS COUNTY	$1170	$668	2,369	2,825	3,251	3,360	3,360	3,360
ALICE	N	CITY OF ALICE - NON POTABLE REUSE	N | DIRECT NON-POTABLE REUSE	N/A	$648	0	897	897	897	897	897
ALICE	N	MUNICIPAL CONSERVATION - ALICE	DEMAND REDUCTION	N/A	$498	0	345	725	899	938	981
BEEVILLE	N	MUNICIPAL CONSERVATION - BEEVILLE	DEMAND REDUCTION	N/A	$498	0	254	502	757	806	806
BISHOP	N	MUNICIPAL CONSERVATION - BISHOP	DEMAND REDUCTION	N/A	$500	0	43	26	23	22	22
CORPUS CHRISTI	N	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)	N | GULF OF MEXICO SALINE	N/A	$1731	0	5,600	5,600	5,600	5,600	5,600
CORPUS CHRISTI	N	MUNICIPAL CONSERVATION - CORPUS C	DEMAND REDUCTION	N/A	$503	0	5,028	10,439	10,550	10,648	10,779
CORPUS CHRISTI NAVAL AIR STATION	N	MUNICIPAL CONSERVATION - CORPUS CHRISTI NAVAL AIR STATION	DEMAND REDUCTION	N/A	$500	0	109	220	325	423	515
COUNTY-OTHER, BEE	N	GULF COAST SUPPLIES - BEE COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | BEE COUNTY	$328	$121	1,682	1,682	1,682	1,682	1,682	1,682
COUNTY-OTHER, BROOKS	N	GULF COAST SUPPLIES - BROOKS COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	$430	$155	309	309	309	309	309	309
COUNTY-OTHER, DUVAL	N	GULF COAST SUPPLIES - DUVAL COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	$442	$155	516	514	516	516	516	516
COUNTY-OTHER, JIM WELLS	N	GULF COAST SUPPLIES - JIM WELLS COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	$392	$108	163	163	163	163	163	163
COUNTY-OTHER, JIM WELLS	N	GULF COAST SUPPLIES - JIM WELLS COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | JIM WELLS COUNTY	$392	$108	2,487	2,487	2,487	2,487	2,487	2,487
COUNTY-OTHER, KENEDY	N	MUNICIPAL CONSERVATION - COUNTY	DEMAND REDUCTION	N/A	$500	0	23	45	65	84	101
COUNTY-OTHER, KLEBERG	N	MUNICIPAL CONSERVATION - COUNTY OTHER (KLEBERG)	DEMAND REDUCTION	N/A	$500	0	10	6	6	6	6
COUNTY-OTHER, NUECES	N	GULF COAST SUPPLIES - NUECES COUNTY OTHER	N | GULF COAST AQUIFER SYSTEM | NUECES COUNTY	$322	$100	1,435	1,435	1,435	1,435	1,435	1,435
EL OSO WSC*	L	DROUGHT MANAGEMENT - EL OSO WSC	DEMAND REDUCTION	$88	N/A	5	0	0	0	0	0
EL OSO WSC*	N	GULF COAST AQUIFER SUPPLIES - REGION N EL OSO WSC	N | GULF COAST AQUIFER SYSTEM | BEE COUNTY	$1317	$1317	108	107	102	100	75	73
EL OSO WSC*	N	MUNICIPAL WATER CONSERVATION - REGION N EL OSO WSC	DEMAND REDUCTION	N/A	$770	0	23	37	42	43	48
FALFURRIAS	N	MUNICIPAL CONSERVATION - FALFURRIAS	DEMAND REDUCTION	N/A	$500	0	132	266	406	546	688
FREER WCID	N	MUNICIPAL CONSERVATION - FREER WCID	DEMAND REDUCTION	N/A	$500	0	54	110	170	211	215
GEORGE WEST	N	MUNICIPAL CONSERVATION - GEORGE WEST	DEMAND REDUCTION	N/A	$500	0	30	42	39	38	38
GREGORY	N	MUNICIPAL CONSERVATION - GREGORY	DEMAND REDUCTION	N/A	$500	0	11	6	6	4	4

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Region N Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
IRRIGATION, BEE	N	GULF COAST SUPPLIES - BEE IRRIGATION	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | BEE COUNTY	$276	$43	352	352	352	352	352	352
IRRIGATION, BEE	N	IRRIGATION CONSERVATION - BEE COUNTY	DEMAND REDUCTION	$4822	$4822	105	210	315	421	526	631
IRRIGATION, JIM WELLS	N	GULF COAST SUPPLIES - JIM WELLS IRRIGATION	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | JIM WELLS COUNTY	$183	$24	333	333	333	333	333	333
IRRIGATION, JIM WELLS	N	IRRIGATION CONSERVATION - JIM WELL	DEMAND REDUCTION	$1911	$1911	48	96	143	191	239	287
IRRIGATION, LIVE OAK	N	GULF COAST SUPPLIES - LIVE OAK IRRIGATION	N | GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	$142	$21	534	534	534	534	534	534
IRRIGATION, LIVE OAK	N	IRRIGATION CONSERVATION - LIVE OAK	DEMAND REDUCTION	$2768	$2768	41	82	122	163	204	245
IRRIGATION, NUECES	N	GULF COAST SUPPLIES - NUECES IRRIGATION	N | GULF COAST AQUIFER SYSTEM | NUECES COUNTY	$471	$39	51	51	51	51	51	51
IRRIGATION, NUECES	N	IRRIGATION CONSERVATION - NUECES C	DEMAND REDUCTION	$1986	$1986	1	3	4	5	6	8
IRRIGATION, SAN PATRICIO	N	GULF COAST SUPPLIES - SAN PATRICIO IRRIGATION	N | GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	$162	$15	20	20	20	20	20	20
IRRIGATION, SAN PATRICIO	N	GULF COAST SUPPLIES - SAN PATRICIO IRRIGATION	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | SAN PATRICIO COUNTY	$162	$15	184	184	184	184	184	184
IRRIGATION, SAN PATRICIO	N	IRRIGATION CONSERVATION - SAN PATRI	DEMAND REDUCTION	$3564	$3564	366	732	1,098	1,465	1,831	2,197
MANUFACTURING, JIM WELLS	N	GULF COAST SUPPLIES - JIM WELLS MANUFACTURING	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | JIM WELLS COUNTY	$688	$125	16	16	16	16	16	16
MANUFACTURING, JIM WELLS	N	MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	2	5	7	10	12	14
MANUFACTURING, KLEBERG	N	GULF COAST SUPPLIES - KLEBERG MANUFACTURING	N | GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	$275	$32	247	247	247	247	247	247
MANUFACTURING, KLEBERG	N	MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	45	103	154	206	257	308
MANUFACTURING, LIVE OAK	N	GULF COAST SUPPLIES - LIVE OAK MANUFACTURING	N | GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	$500	$36	28	28	28	28	28	28
MANUFACTURING, LIVE OAK	N	MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	57	125	187	249	312	374
MANUFACTURING, NUECES	N	CITY OF CORPUS CHRISTI ASR	N | GULF COAST AQUIFER SYSTM ASR (CORPUS CHRISTI) | NUECES COUNTY	N/A	$171	0	14,573	14,573	14,573	14,573	14,573
MANUFACTURING, NUECES	N	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)	N | GULF OF MEXICO SALINE	N/A	$1731	0	5,601	5,601	5,601	5,601	5,601
MANUFACTURING, NUECES	N	EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | SAN PATRICIO COUNTY	N/A	$1150	0	9,949	9,949	9,949	11,394	11,394
MANUFACTURING, NUECES	N	MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	1,135	2,518	3,777	5,036	6,295	7,554
MANUFACTURING, NUECES	N	O.N. STEVENS WATER TREATMENT PLANT IMPROVEMENTS	N | CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	$565	$415	1,409	1,417	1,422	1,425	1,426	1,426

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region N Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
MANUFACTURING, NUECES	N	PORT OF CORPUS CHRISTI AUTHORITY SEAWATER DESALINATION - HARBOR ISLAND	N | GULF OF MEXICO SALINE	N/A	$1315	0	28,022	28,022	28,022	28,022	28,022
MANUFACTURING, SAN PATRICIO	N	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (LA QUINTA)	N | GULF OF MEXICO SALINE	N/A	$1479	0	22,402	22,402	22,402	22,402	22,402
MANUFACTURING, SAN PATRICIO	N	EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | SAN PATRICIO COUNTY	N/A	$1150	0	9,949	9,949	9,949	11,394	11,394
MANUFACTURING, SAN PATRICIO	N	MANUFACTURING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	971	2,161	3,242	4,322	5,403	6,483
MANUFACTURING, SAN PATRICIO	N	O.N. STEVENS WATER TREATMENT PLANT IMPROVEMENTS	N | CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	$565	$415	1,409	1,416	1,422	1,426	1,426	1,427
MANUFACTURING, SAN PATRICIO	N	PORT OF CORPUS CHRISTI AUTHORITY SEAWATER DESALINATION - HARBOR ISLAND	N | GULF OF MEXICO SALINE	N/A	$1315	0	28,022	28,022	28,022	28,022	28,022
MANUFACTURING, SAN PATRICIO	N	PORT OF CORPUS CHRISTI AUTHORITY SEAWATER DESALINATION - LA QUINTA CHANNEL	N | GULF OF MEXICO SALINE	N/A	$1362	0	33,604	33,604	33,604	33,604	33,604
MANUFACTURING, SAN PATRICIO	N	POSEIDON REGIONAL SEAWATER DESALINATION PROJECT AT INGLESIDE	N | GULF OF MEXICO SALINE	N/A	$1296	0	56,044	56,044	56,044	56,044	56,044
MANUFACTURING, SAN PATRICIO	N	REGIONAL INDUSTRIAL WASTEWATER REUSE PLAN (SPMWD)	N | DIRECT NON-POTABLE REUSE	N/A	$69	0	5,010	5,010	5,010	5,010	5,010
MINING, BEE	N	GULF COAST SUPPLIES - BEE MINING	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | BEE COUNTY	$259	$36	197	197	197	197	197	197
MINING, BEE	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	10	20	28	33	37	42
MINING, BROOKS	N	GULF COAST SUPPLIES - BROOKS MINING	N | GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	$291	$55	182	182	182	182	182	182
MINING, BROOKS	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	9	18	26	32	39	45
MINING, DUVAL	N	GULF COAST SUPPLIES - DUVAL MINING	N | GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	$357	$61	768	768	768	768	768	768
MINING, DUVAL	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	35	72	101	124	146	166
MINING, JIM WELLS	N	GULF COAST SUPPLIES - JIM WELLS MINING	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | JIM WELLS COUNTY	$309	$55	55	55	55	55	55	55
MINING, JIM WELLS	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	2	4	4	4	3	3
MINING, KENEDY	N	GULF COAST SUPPLIES - KENEDY MINING	N | GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	$587	$63	63	63	63	63	63	63
MINING, KENEDY	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	3	6	7	7	5	4
MINING, KLEBERG	N	GULF COAST SUPPLIES - KLEBERG MINING	N | GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	$359	$42	142	142	142	142	142	142
MINING, KLEBERG	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	9	18	26	32	39	45
MINING, NUECES	N	GULF COAST SUPPLIES - NUECES MINING	N | GULF COAST AQUIFER SYSTEM | NUECES COUNTY	$158	$20	1,127	1,127	1,127	1,127	1,127	1,127

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Region N Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
MINING, NUECES	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	1	2	3	4	6	8
MINING, SAN PATRICIO	N	GULF COAST SUPPLIES - SAN PATRICIO MINING	N | GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	$229	$28	84	84	84	84	84	84
MINING, SAN PATRICIO	N	GULF COAST SUPPLIES - SAN PATRICIO MINING	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | SAN PATRICIO COUNTY	$229	$28	314	314	314	314	314	314
MINING, SAN PATRICIO	N	MINING WATER CONSERVATION	DEMAND REDUCTION	$0	$0	7	17	26	36	49	63
NAVAL AIR STATION KINGSVILLE	N	MUNICIPAL CONSERVATION - NAVAL AIR STATION KINGSVILLE	DEMAND REDUCTION	N/A	$500	0	26	54	84	114	144
NUECES COUNTY WCID 3	N	LOCAL BALANCING RESERVOIR	N | LOCAL BALANCING RESERVOIR	$426	$98	3,824	3,800	3,788	3,780	3,771	3,765
NUECES COUNTY WCID 3	N	MUNICIPAL CONSERVATION - NUECES C	DEMAND REDUCTION	N/A	$498	0	328	638	936	1,219	1,477
NUECES COUNTY WCID 4	N	MUNICIPAL CONSERVATION - NUECES C	DEMAND REDUCTION	N/A	$500	0	233	473	706	929	1,134
NUECES WSC	N	MUNICIPAL CONSERVATION - NUECES WSC	DEMAND REDUCTION	N/A	$500	0	31	28	29	30	35
ORANGE GROVE	N	MUNICIPAL CONSERVATION - ORANGE	DEMAND REDUCTION	N/A	$500	0	40	83	131	181	232
PREMONT	N	MUNICIPAL CONSERVATION - PREMONT	DEMAND REDUCTION	N/A	$500	0	58	120	194	268	302
RIVER ACRES WSC	N	LOCAL BALANCING RESERVOIR	N | LOCAL BALANCING RESERVOIR	$426	$98	234	258	270	278	287	293
ROCKPORT	N	MUNICIPAL CONSERVATION - ROCKPOR	DEMAND REDUCTION	N/A	$498	0	270	353	327	321	321
SAN DIEGO MUD 1	N	GULF COAST SUPPLIES - SAN DIEGO MUD 1	N | GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	$453	$139	417	417	417	417	417	417
SAN DIEGO MUD 1	N	MUNICIPAL CONSERVATION - SAN DIEG	DEMAND REDUCTION	N/A	$500	0	68	109	102	103	107
SINTON	N	MUNICIPAL CONSERVATION - SINTON	DEMAND REDUCTION	N/A	$500	0	106	211	219	427	430
TDCJ CHASE FIELD	N	GULF COAST SUPPLIES - TDCJ CHASE FIELD	N | GULF COAST AQUIFER SYSTEM FRESH/BRACKISH | BEE COUNTY	$404	$168	208	208	208	208	208	208
TDCJ CHASE FIELD	N	MUNICIPAL CONSERVATION - TDCJ CHA	DEMAND REDUCTION	N/A	$500	0	85	167	247	322	391
THREE RIVERS	N	MUNICIPAL CONSERVATION - THREE RIV	DEMAND REDUCTION	N/A	$500	0	37	24	18	17	17

	2020	2030	2040	2050	2060	2070
REGION N RECOMMENDED WMS SUPPLY TOTAL	24,119	254,944	265,796	270,577	277,931	282,091

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Region N Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
ALICE	NO	2020	CITY OF ALICE - BRACKISH GROUNDWATER DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; PUMP STATION; NEW WATER TREATMENT PLANT	$23,983,000
ALICE	NO	2030	CITY OF ALICE - NONPOTABLE REUSE	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$10,222,000
ALICE	NO	2030	MUNICIPAL CONSERVATION - ALICE	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$4,862,000
BEEVILLE	NO	2030	MUNICIPAL CONSERVATION - BEEVILLE	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$3,991,000
BISHOP	NO	2030	MUNICIPAL CONSERVATION - BISHOP	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$213,000
CORPUS CHRISTI	YES	2030	CITY OF CORPUS CHRISTI ASR	MULTIPLE WELLS/WELL FIELD; PUMP STATION; STORAGE TANK; WATER TREATMENT PLANT EXPANSION; INJECTION WELL	$90,199,000
CORPUS CHRISTI	YES	2030	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)	CONVEYANCE/TRANSMISSION PIPELINE; STORAGE TANK; NEW WATER TREATMENT PLANT	$236,693,000
CORPUS CHRISTI	YES	2030	CITY OF CORPUS CHRISTI SEAWATER DESALINATION (LA QUINTA)	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; NEW WATER TREATMENT PLANT	$420,372,000
CORPUS CHRISTI	YES	2030	EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$78,775,000
CORPUS CHRISTI	YES	2030	MUNICIPAL CONSERVATION - CORPUS CHRISTI	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$53,940,000
CORPUS CHRISTI	YES	2020	O.N. STEVENS WTP IMPROVEMENTS	WATER TREATMENT PLANT EXPANSION; PUMP STATION; SURFACE WATER INTAKE MODIFICATION	$68,212,000
CORPUS CHRISTI NAVAL AIR STATION	NO	2030	MUNICIPAL CONSERVATION - CORPUS CHRISTI NAVAL AIR STATION	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$2,560,000
COUNTY-OTHER, BEE	NO	2020	GULF COAST SUPPLIES - BEE COUNTY OTHER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$4,943,000
COUNTY-OTHER, BROOKS	NO	2020	GULF COAST SUPPLIES - BROOKS COUNTY OTHER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$1,207,000
COUNTY-OTHER, DUVAL	NO	2020	GULF COAST SUPPLIES - DUVAL COUNTY OTHER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$2,109,000
COUNTY-OTHER, JIM WELLS	NO	2020	GULF COAST SUPPLIES - JIM WELLS COUNTY OTHER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$10,704,000
COUNTY-OTHER, KENEDY	NO	2030	MUNICIPAL CONSERVATION - COUNTY OTHER (KENEDY)	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$503,000
COUNTY-OTHER, KLEBERG	NO	2030	MUNICIPAL CONSERVATION - COUNTY OTHER (KLEBERG)	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$51,000
COUNTY-OTHER, NUECES	NO	2020	GULF COAST SUPPLIES - NUECES COUNTY OTHER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT	$4,514,000
EL OSO WSC	NO	2020	GULF COAST AQUIFER SUPPLIES - REGION N EL OSO WSC	CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL	$424,000
EL OSO WSC	NO	2030	MUNICIPAL CONSERVATION - REGION N EL OSO WSC	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$297,000
FALFURRIAS	NO	2030	MUNICIPAL CONSERVATION - FALFURRIAS	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$3,423,000
FREER WCID	NO	2030	MUNICIPAL CONSERVATION - FREER WCID	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$1,070,000
GEORGE WEST	NO	2030	MUNICIPAL CONSERVATION - GEORGE WEST	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$207,000
GREGORY	NO	2030	MUNICIPAL CONSERVATION - GREGORY	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$55,000
IRRIGATION, BEE	NO	2020	GULF COAST SUPPLIES - BEE IRRIGATION	MULTIPLE WELLS/WELL FIELD	$1,166,000
IRRIGATION, BEE	NO	2020	IRRIGATION CONSERVATION - BEE COUNTY	CONSERVATION - AGRICULTURAL	$3,041,704

Region N Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
IRRIGATION, JIM WELLS	NO	2020	GULF COAST SUPPLIES - JIM WELLS IRRIGATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$753,000
IRRIGATION, JIM WELLS	NO	2020	IRRIGATION CONSERVATION - JIM WELLS COUNTY	CONSERVATION - AGRICULTURAL	$548,471
IRRIGATION, LIVE OAK	NO	2020	GULF COAST SUPPLIES - LIVE OAK IRRIGATION	MULTIPLE WELLS/WELL FIELD	$917,000
IRRIGATION, LIVE OAK	NO	2020	IRRIGATION CONSERVATION - LIVE OAK COUNTY	CONSERVATION - AGRICULTURAL	$676,687
IRRIGATION, NUECES	NO	2020	GULF COAST SUPPLIES - NUECES IRRIGATION	MULTIPLE WELLS/WELL FIELD	$319,000
IRRIGATION, NUECES	NO	2020	IRRIGATION CONSERVATION - NUECES COUNTY	CONSERVATION - AGRICULTURAL	$15,196
IRRIGATION, SAN PATRICIO	NO	2020	GULF COAST SUPPLIES - SAN PATRICIO IRRIGATION	MULTIPLE WELLS/WELL FIELD	$420,000
IRRIGATION, SAN PATRICIO	NO	2020	IRRIGATION CONSERVATION - SAN PATRICIO COUNTY	CONSERVATION - AGRICULTURAL	$7,829,259
MANUFACTURING, JIM WELLS	NO	2020	GULF COAST SUPPLIES - JIM WELLS MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$129,000
MANUFACTURING, KLEBERG	NO	2020	GULF COAST SUPPLIES - KLEBERG MANUFACTURING	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$852,000
MANUFACTURING, LIVE OAK	NO	2020	GULF COAST SUPPLIES - LIVE OAK MANUFACTURING	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$188,000
MINING, BEE	NO	2020	GULF COAST SUPPLIES - BEE MINING	MULTIPLE WELLS/WELL FIELD	$622,000
MINING, BROOKS	NO	2020	GULF COAST SUPPLIES - BROOKS MINING	MULTIPLE WELLS/WELL FIELD	$615,000
MINING, DUVAL	NO	2020	GULF COAST SUPPLIES - DUVAL MINING	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,228,000
MINING, JIM WELLS	NO	2020	GULF COAST SUPPLIES - JIM WELLS MINING	MULTIPLE WELLS/WELL FIELD	$202,000
MINING, KENEDY	NO	2020	GULF COAST SUPPLIES - KENEDY MINING	MULTIPLE WELLS/WELL FIELD	$469,000
MINING, KLEBERG	NO	2020	GULF COAST SUPPLIES - KLEBERG MINING	MULTIPLE WELLS/WELL FIELD	$638,000
MINING, NUECES	NO	2020	GULF COAST SUPPLIES - NUECES MINING	MULTIPLE WELLS/WELL FIELD	$2,200,000
MINING, SAN PATRICIO	NO	2020	GULF COAST SUPPLIES - SAN PATRICIO MINING	MULTIPLE WELLS/WELL FIELD	$1,141,000
NAVAL AIR STATION KINGSVILLE	NO	2030	MUNICIPAL CONSERVATION - NAVAL AIR STATION KINGSVILLE	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$716,000
NUECES COUNTY WCID 3	YES	2020	LOCAL BALANCING STORAGE RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; PUMP STATION; RESERVOIR CONSTRUCTION	$21,575,000
NUECES COUNTY WCID 3	YES	2030	MUNICIPAL CONSERVATION - NUECES COUNTY WCID 3	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$7,316,000
NUECES COUNTY WCID 4	NO	2030	MUNICIPAL CONSERVATION - NUECES COUNTY WCID 4	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$5,640,000
NUECES WSC	NO	2030	MUNICIPAL CONSERVATION - NUECES WSC	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$177,000
ORANGE GROVE	NO	2030	MUNICIPAL CONSERVATION - ORANGE GROVE	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$1,153,000
PORT OF CORPUS CHRISTI AUTHORITY	YES	2030	PORT OF CORPUS CHRISTI AUTHORITY SEAWATER DESALINATION - HARBOR ISLAND	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; NEW WATER TREATMENT PLANT	$802,807,000
PORT OF CORPUS CHRISTI AUTHORITY	YES	2030	PORT OF CORPUS CHRISTI AUTHORITY SEAWATER DESALINATION - LA QUINTA CHANNEL	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; NEW WATER TREATMENT PLANT	$457,732,000
POSEIDON WATER	YES	2030	POSEIDON REGIONAL SEAWATER DESALINATION PROJECT AT INGLESIDE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; NEW WATER TREATMENT PLANT	$724,984,000
PREMONT	NO	2030	MUNICIPAL CONSERVATION - PREMONT	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$1,504,000
ROCKPORT	NO	2030	MUNICIPAL CONSERVATION - ROCKPORT	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$1,751,000
SAN DIEGO MUD 1	NO	2020	GULF COAST SUPPLIES - SAN DIEGO MUD 1	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; WATER TREATMENT PLANT EXPANSION	$1,856,000
SAN DIEGO MUD 1	NO	2030	MUNICIPAL CONSERVATION - SAN DIEGO MUD 1	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$538,000
SAN PATRICIO MWD	YES	2030	EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$78,775,000

Region N Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
SAN PATRICIO MWD	YES	2030	REGIONAL INDUSTRIAL WASTEWATER REUSE PLAN (SPMWD)	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$115,502,000
SINTON	NO	2030	MUNICIPAL CONSERVATION - SINTON	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$2,137,000
TDCJ CHASE FIELD	NO	2020	GULF COAST SUPPLIES - TDCJ CHASE FIELD	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$703,000
TDCJ CHASE FIELD	NO	2030	MUNICIPAL CONSERVATION - TDCJ CHASE FIELD	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$1,947,000
THREE RIVERS	YES	2030	MUNICIPAL CONSERVATION - THREE RIVERS	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)	$183,000

REGION N RECOMMENDED CAPITAL COST TOTAL	**$3,276,495,317**

Region N Alternative Water User Group (WUG) Water Management Strategies (WMS)

WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
REGION N ALTERNATIVE WMS SUPPLY TOTAL											

This results of this table are intentionally blank. Not applicable for Region N.

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region N Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
				REGION N ALTERNATIVE CAPITAL COST TOTAL	

This results of this table are intentionally blank. Not applicable for Region N.

Region N Water User Group (WUG) Management Supply Factor

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin, the combined total of existing and future supply is divided by the total projected demand. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ALICE	1.5	1.9	2.0	2.0	1.9	1.9
ARANSAS PASS	1.0	1.0	1.0	1.0	1.0	1.0
BAFFIN BAY WSC	1.0	1.0	1.0	1.0	1.0	1.0
BEEVILLE	1.0	1.1	1.1	1.2	1.2	1.2
BISHOP	1.0	1.1	1.0	1.0	1.0	1.0
CORPUS CHRISTI	1.0	1.2	1.2	1.2	1.2	1.2
CORPUS CHRISTI NAVAL AIR STATION	1.0	1.1	1.2	1.3	1.3	1.4
COUNTY-OTHER, ARANSAS	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, BEE	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, BROOKS	1.5	1.4	1.3	1.1	1.1	1.0
COUNTY-OTHER, DUVAL	1.1	1.1	1.1	1.0	1.0	1.0
COUNTY-OTHER, JIM WELLS	1.3	1.2	1.2	1.1	1.0	1.0
COUNTY-OTHER, KENEDY	1.0	1.1	1.2	1.2	1.3	1.4
COUNTY-OTHER, KLEBERG	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, LIVE OAK	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, MCMULLEN	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, NUECES	1.1	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, SAN PATRICIO	1.0	1.0	1.0	1.0	1.0	1.0
DRISCOLL	1.0	1.0	1.0	1.0	1.0	1.0
DUVAL COUNTY CRD	1.0	1.0	1.0	1.0	1.0	1.0
EL OSO WSC*	1.0	1.1	1.2	1.2	1.1	1.1
FALFURRIAS	1.0	1.1	1.2	1.2	1.3	1.4
FREER WCID	1.0	1.1	1.2	1.2	1.3	1.3
GEORGE WEST	1.0	1.1	1.1	1.1	1.1	1.1
GREGORY	1.0	1.0	1.0	1.0	1.0	1.0
INGLESIDE	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, BEE	1.0	1.0	1.1	1.1	1.1	1.1
IRRIGATION, BROOKS	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, DUVAL	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, JIM WELLS	1.0	1.1	1.1	1.1	1.1	1.2
IRRIGATION, KLEBERG	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, LIVE OAK	1.1	1.1	1.1	1.1	1.1	1.2
IRRIGATION, NUECES	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, SAN PATRICIO	1.0	1.0	1.1	1.1	1.1	1.2
JIM WELLS COUNTY FWSD 1	1.0	1.0	1.0	1.0	1.0	1.0
KINGSVILLE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, ARANSAS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, BEE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, BROOKS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, DUVAL	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, JIM WELLS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, KENEDY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, KLEBERG	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, LIVE OAK	1.0	1.0	1.0	1.0	1.0	1.0

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region N Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LIVESTOCK, MCMULLEN	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, NUECES	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, SAN PATRICIO	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, BROOKS	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, JIM WELLS	1.2	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, KLEBERG	1.2	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, LIVE OAK	1.0	1.1	1.1	1.1	1.1	1.2
MANUFACTURING, MCMULLEN	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, NUECES	1.1	2.1	2.0	2.0	2.0	2.0
MANUFACTURING, SAN PATRICIO	1.1	4.5	4.5	4.4	4.4	4.4
MATHIS	1.0	1.0	1.0	1.0	1.0	1.0
MCCOY WSC*	2.2	1.9	1.8	1.6	1.5	1.4
MINING, ARANSAS	1.0	1.0	1.0	1.0	1.0	1.0
MINING, BEE	1.0	1.1	1.2	1.3	1.5	1.6
MINING, BROOKS	1.0	1.1	1.1	1.2	1.3	1.4
MINING, DUVAL	1.1	1.0	1.1	1.3	1.4	1.5
MINING, JIM WELLS	1.1	1.1	1.4	2.0	3.0	4.4
MINING, KENEDY	1.1	1.0	1.4	1.9	2.6	3.5
MINING, KLEBERG	1.0	1.1	1.1	1.2	1.3	1.4
MINING, LIVE OAK	1.0	1.0	1.0	1.0	1.0	1.0
MINING, MCMULLEN	1.0	1.0	1.0	1.0	1.0	1.0
MINING, NUECES	1.7	1.4	1.3	1.2	1.1	1.0
MINING, SAN PATRICIO	1.5	1.3	1.3	1.2	1.2	1.1
NAVAL AIR STATION KINGSVILLE	1.0	1.1	1.2	1.3	1.3	1.4
NUECES COUNTY WCID 3	1.0	1.1	1.2	1.2	1.3	1.4
NUECES COUNTY WCID 4	1.0	1.1	1.2	1.2	1.3	1.4
NUECES WSC	1.0	1.1	1.0	1.0	1.0	1.0
ODEM	1.0	1.0	1.0	1.0	1.0	1.0
ORANGE GROVE	1.0	1.1	1.2	1.2	1.3	1.4
PETTUS MUD	1.0	1.0	1.0	1.0	1.0	1.0
PORTLAND	1.0	1.0	1.0	1.0	1.0	1.0
PREMONT	1.0	1.1	1.2	1.2	1.3	1.3
RICARDO WSC	1.0	1.0	1.0	1.0	1.0	1.0
RINCON WSC	1.0	1.0	1.0	1.0	1.0	1.0
RIVER ACRES WSC	1.0	1.0	1.0	1.0	1.0	1.0
RIVIERA WATER SYSTEM	1.0	1.0	1.0	1.0	1.0	1.0
ROCKPORT	1.0	1.1	1.1	1.1	1.1	1.1
SAN DIEGO MUD 1	1.1	1.2	1.2	1.2	1.1	1.1
SINTON	1.0	1.1	1.2	1.2	1.3	1.3
STEAM ELECTRIC POWER, NUECES	1.0	1.0	1.0	1.0	1.0	1.0
STEAM ELECTRIC POWER, SAN PATRICIO	1.0	1.0	1.0	1.0	1.0	1.0
TAFT	1.0	1.0	1.0	1.0	1.0	1.0
TDCJ CHASE FIELD	1.0	1.1	1.2	1.2	1.3	1.4
THREE RIVERS	1.0	1.1	1.0	1.0	1.0	1.0
VIOLET WSC	1.0	1.0	1.0	1.0	1.0	1.0

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region N Recommended Water Management Strategy (WMS) Supply Associated with a New or Amended Inter-Basin Transfer (IBT) Permit

IBT WMS supply is the portion of the total WMS benefitting WUGs that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085.

			IBT WMS SUPPLY (ACRE-FEET PER YEAR)					
WMS NAME	**SOURCE BASIN**	**RECIPIENT WUG BASIN**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

This results of this table are intentionally blank. Not applicable for Region N.

Region N Water User Groups (WUGs)
Recommended Water Management Strategy (WMS) Supply Associated with a
New or Amended Inter-Basin Transfer (IBT) Permit and Total Recommended Conservation WMS Supply

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code§ 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

BENEFITTING WUG NAME | BASIN	WMS SOURCE ORIGIN BASIN | WMS NAME	WMS SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070

This results of this table are intentionally blank. Not applicable for Region N.

Region N Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

WMS NAME	WMS SPONSOR	SOURCE NAME	UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
TOTAL UNALLOCATED STRATEGY SUPPLIES								

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an ‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

This results of this table are intentionally blank. Not applicable for Region N.

Region N Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

WMS TYPE *	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	14,573	14,573	14,573	14,573	14,573
DROUGHT MANAGEMENT	5	0	0	0	0	0
GROUNDWATER DESALINATION	2,369	22,723	23,149	23,258	26,148	26,148
GROUNDWATER WELLS & OTHER	12,022	12,019	12,016	12,014	11,989	11,987
IRRIGATION CONSERVATION	561	1,123	1,682	2,245	2,806	3,368
MUNICIPAL CONSERVATION	0	7,344	14,684	16,281	17,700	18,793
OTHER CONSERVATION	2,286	5,069	7,588	10,095	12,603	15,109
OTHER DIRECT REUSE	0	5,907	5,907	5,907	5,907	5,907
OTHER SURFACE WATER	6,876	6,891	6,902	6,909	6,910	6,911
SEAWATER DESALINATION	0	179,295	179,295	179,295	179,295	179,295
NEW MAJOR RESERVOIR	0	0	0	0	0	0
OTHER STRATEGIES	0	0	0	0	0	0
INDIRECT REUSE	0	0	0	0	0	0
CONJUNCTIVE USE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	0	0	0	0	0
TOTAL STRATEGY SUPPLIES	**24,119**	**254,944**	**265,796**	**270,577**	**277,931**	**282,091**

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf

Region N Water User Group (WUG)
Recommended Water Management Strategy (WMS) Supplies by Source Type

SOURCE SUBTYPE*	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	14,573	14,573	14,573	14,573	14,573
GROUNDWATER	14,391	34,742	35,165	35,272	38,137	38,135
GROUNDWATER TOTAL STRATEGY SUPPLIES	**14,391**	**49,315**	**49,738**	**49,845**	**52,710**	**52,708**
DIRECT NON-POTABLE REUSE	0	5,907	5,907	5,907	5,907	5,907
DIRECT POTABLE REUSE	0	0	0	0	0	0
INDIRECT NON-POTABLE REUSE	0	0	0	0	0	0
INDIRECT POTABLE REUSE	0	0	0	0	0	0
REUSE TOTAL STRATEGY SUPPLIES	**0**	**5,907**	**5,907**	**5,907**	**5,907**	**5,907**
ATMOSPHERE	0	0	0	0	0	0
GULF OF MEXICO	0	179,295	179,295	179,295	179,295	179,295
LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
OTHER LOCAL SUPPLY	0	0	0	0	0	0
RAINWATER HARVESTING	0	0	0	0	0	0
RESERVOIR	4,058	4,058	4,058	4,058	4,058	4,058
RESERVOIR SYSTEM	2,818	2,833	2,844	2,851	2,852	2,853
RUN-OF-RIVER	0	0	0	0	0	0
SURFACE WATERTOTAL STRATEGY SUPPLIES	**6,876**	**186,186**	**186,197**	**186,204**	**186,205**	**186,206**
REGION N TOTAL STRATEGY SUPPLIES	**21,267**	**241,408**	**241,842**	**241,956**	**244,822**	**244,821**

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region N Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

CORPUS CHRISTI - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	64,110	68,180	70,493	71,888	73,258	74,240
PROJECTED WHOLESALE CONTRACT DEMANDS	111,414	107,920	103,408	99,812	96,242	92,759
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**175,524**	**176,100**	**173,901**	**171,700**	**169,500**	**166,999**
SURFACE WATER SALES TO RETAIL CUSTOMERS	64,110	68,180	70,493	71,888	73,258	74,240
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	111,072	105,087	100,563	96,961	93,390	89,907
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**175,182**	**173,267**	**171,056**	**168,849**	**166,648**	**164,147**

NUECES COUNTY WCID 3 - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	4,004	3,992	3,952	3,933	3,929	3,928
PROJECTED WHOLESALE CONTRACT DEMANDS	426	450	462	470	479	485
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**4,430**	**4,442**	**4,414**	**4,403**	**4,408**	**4,413**
SURFACE WATER SALES TO RETAIL CUSTOMERS	192	192	192	192	192	192
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	192	192	192	192	192	192
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**384**	**384**	**384**	**384**	**384**	**384**

SAN PATRICIO MWD - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	51,101	51,094	51,088	51,086	51,087	51,091
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**51,101**	**51,094**	**51,088**	**51,086**	**51,087**	**51,091**
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	53,577	50,957	48,523	46,043	43,560	40,792
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**53,577**	**50,957**	**48,523**	**46,043**	**43,560**	**40,792**

SOUTH TEXAS WATER AUTHORITY - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	1,875	2,170	2,341	2,530	2,994	3,331
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	1,875	2,170	2,341	2,530	2,994	3,331
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**1,875**	**2,170**	**2,341**	**2,530**	**2,994**	**3,331**

Region N Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale o water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

CORPUS CHRISTI | CITY OF CORPUS CHRISTI ASR

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	14,573	14,573	14,573	14,573	14,573

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
CITY OF CORPUS CHRISTI ASR	MULTIPLE WELLS/WELL FIELD; PUMP STATION; STORAGE TANK; WATER TREATMENT PLANT EXPANSION; INJECTION WELL

CORPUS CHRISTI | CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	5,600	5,600	5,600	5,600	5,600
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	5,601	5,601	5,601	5,601	5,601
TOTAL MWP RELATED WMS SUPPLY	0	11,201	11,201	11,201	11,201	11,201

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
CITY OF CORPUS CHRISTI SEAWATER DESALINATION (INNER HARBOR)	CONVEYANCE/TRANSMISSION PIPELINE; STORAGE TANK; NEW WATER TREATMENT PLANT

CORPUS CHRISTI | CITY OF CORPUS CHRISTI SEAWATER DESALINATION (LA QUINTA)

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	22,402	22,402	22,402	22,402	22,402

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
CITY OF CORPUS CHRISTI SEAWATER DESALINATION (LA QUINTA)	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; NEW WATER TREATMENT PLANT

CORPUS CHRISTI | MUNICIPAL CONSERVATION - CORPUS CHRISTI

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	5,028	10,439	10,550	10,648	10,779

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
MUNICIPAL CONSERVATION - CORPUS CHRISTI	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)

CORPUS CHRISTI | O.N. STEVENS WATER TREATMENT PLANT IMPROVEMENTS

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	2,818	2,833	2,844	2,851	2,852	2,853

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
O.N. STEVENS WTP IMPROVEMENTS	WATER TREATMENT PLANT EXPANSION; PUMP STATION; SURFACE WATER INTAKE MODIFICATION

NUECES COUNTY WCID 3 | LOCAL BALANCING RESERVOIR

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	3,824	3,800	3,788	3,780	3,771	3,765
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	234	258	270	278	287	293

Region N Major Water Provider (MWP) Water Management Strategy (WMS) Summary

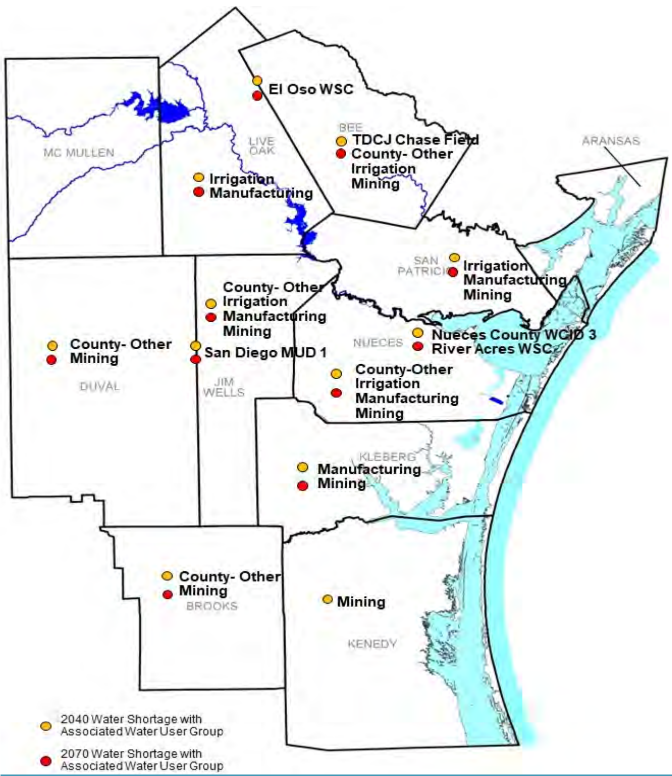
TOTAL MWP RELATED WMS SUPPLY	4,058	4,058	4,058	4,058	4,058	4,058
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
LOCAL BALANCING STORAGE RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; PUMP STATION; RESERVOIR CONSTRUCTION					

NUECES COUNTY WCID 3 | MUNICIPAL CONSERVATION - NUECES COUNTY WCID 3						
DATA DESCRIPTION	**WATER VOLUMES (ACRE-FEET PER YEAR)**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
MWP RETAIL CUSTOMERS	0	328	638	936	1,219	1,477
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
MUNICIPAL CONSERVATION - NUECES COUNTY WCID 3	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS)					

SAN PATRICIO MWD | EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT						
DATA DESCRIPTION	**WATER VOLUMES (ACRE-FEET PER YEAR)**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	19,898	19,898	19,898	22,788	22,788
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
EVANGELINE/LAGUNA TREATED GROUNDWATER PROJECT	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK					

SAN PATRICIO MWD | REGIONAL INDUSTRIAL WASTEWATER REUSE PLAN (SPMWD)						
DATA DESCRIPTION	**WATER VOLUMES (ACRE-FEET PER YEAR)**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	5,010	5,010	5,010	5,010	5,010
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
REGIONAL INDUSTRIAL WASTEWATER REUSE PLAN (SPMWD)	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK					

SOUTH TEXAS WATER AUTHORITY | NO RECOMMENDED WMS SUPPLY RELATED TO MWP



Appendix B

TWDB Socioeconomic Report

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Socioeconomic Impacts of Projected Water Shortages for the Coastal Bend (Region N) Regional Water Planning Area

Prepared in Support of the 2021 Region N Regional Water Plan

Dr. John R. Ellis
Water Use, Projections, & Planning Division
Texas Water Development Board

November 2019

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Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required analysis in the regional water planning process. The Texas Water Development Board (TWDB) estimates these impacts for regional water planning groups (RWPGs) and summarizes the impacts in the state water plan. The analysis presented is for the Coastal Bend Regional Water Planning Group (Region N).

Based on projected water demands and existing water supplies, Region N identified water needs (potential shortages) that could occur within its region under a repeat of the drought of record for six water use categories (irrigation, livestock, manufacturing, mining, municipal and steam-electric power). The TWDB then estimated the annual socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

This analysis was performed using an economic impact modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year repeat of the drought of record with the further caveat that no mitigation strategies are implemented. Decade specific impact estimates assume that growth occurs, and future shocks are imposed on an economy at 10-year intervals. The estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

For regional economic impacts, income losses and job losses are estimated within each planning decade (2020 through 2070). The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts are estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

IMPLAN data reported that Region N generated more than $31 billion in GDP (2018 dollars) and supported roughly 328,000 jobs in 2016. The Region N estimated total population was approximately 592,000 in 2016.

It is estimated that not meeting the identified water needs in Region N would result in an annually combined lost income impact of approximately $732 million in 2020, increasing to $6.9 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 6,000 jobs, and by 2070 job losses would increase to approximately 48,000 if anticipated needs are not mitigated.

All impact estimates are in year 2018 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and the Texas Municipal League.

Table ES-1 Region N socioeconomic impact summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$732	$1,930	$3,178	$4,662	$5,998	$6,914
Job losses	5,955	13,686	22,208	32,324	41,429	47,613
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$80	$170	$259	$366	$462	$529
Water trucking costs ($ millions)*	$48	$50	$50	$51	$52	$52
Utility revenue losses ($ millions)*	$29	$30	$31	$31	$32	$32
Utility tax revenue losses ($ millions)*	$1	$1	$1	$1	$1	$1
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$158	$163	$166	$168	$171	$172
Population losses	1,093	2,513	4,077	5,935	7,606	8,742
School enrollment losses	209	481	780	1,135	1,455	1,672

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on the regional economy in the short term, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government, and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

As part of the regional water planning process, RWPGs must evaluate the social and economic impacts of not meeting water needs (31 Texas Administrative Code §357.33 (c)). Due to the complexity of the analysis and limited resources of the planning groups, the TWDB has historically performed this analysis for the RWPGs upon their request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of Region N, and those efforts for this region as well as the other 15 regions allow consistency and a degree of comparability in the approach.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 provides a snapshot of the region's economy and summarizes the identified water needs in each water use category, which were calculated based on the RWPG's water supply and demand established during the regional water planning process. Section 2 defines each of ten impact assessment measures used in this analysis. Section 3 describes the methodology for the impact assessment and the approaches and assumptions specific to each water use category (i.e., irrigation, livestock, manufacturing, mining, municipal, and steam-electric power). Section 4 presents the impact estimates for each water use category with results summarized for the region as a whole. Appendix A presents a further breakdown of the socioeconomic impacts by county.

1.1 Regional Economic Summary

The Region N Regional Water Planning Area generated more than $31 billion in gross domestic product (2018 dollars) and supported roughly 328,000 jobs in 2016, according to the IMPLAN dataset utilized in this socioeconomic analysis. This activity accounted for 1.8 percent of the state's total gross domestic product of 1.73 trillion dollars for the year based on IMPLAN. Table 1-1 lists all economic sectors ranked by the total value-added to the economy in Region N. The manufacturing and mining sectors (including petroleum refineries and oil and gas extraction) generated more than 25 percent of the region's total value-added and were also significant sources of tax revenue. The top employers in the region were in the public administration, health care, and construction sectors. Region N's estimated total population was roughly 592,000 in 2016, approximately 2 percent of the state's total.

This represents a snapshot of the regional economy as a whole, and it is important to note that not all economic sectors were included in the TWDB socioeconomic impact analysis. Data considerations prompted use of only the more water-intensive sectors within the economy because damage estimates could only be calculated for those economic sectors which had both reliable income and water use estimates.

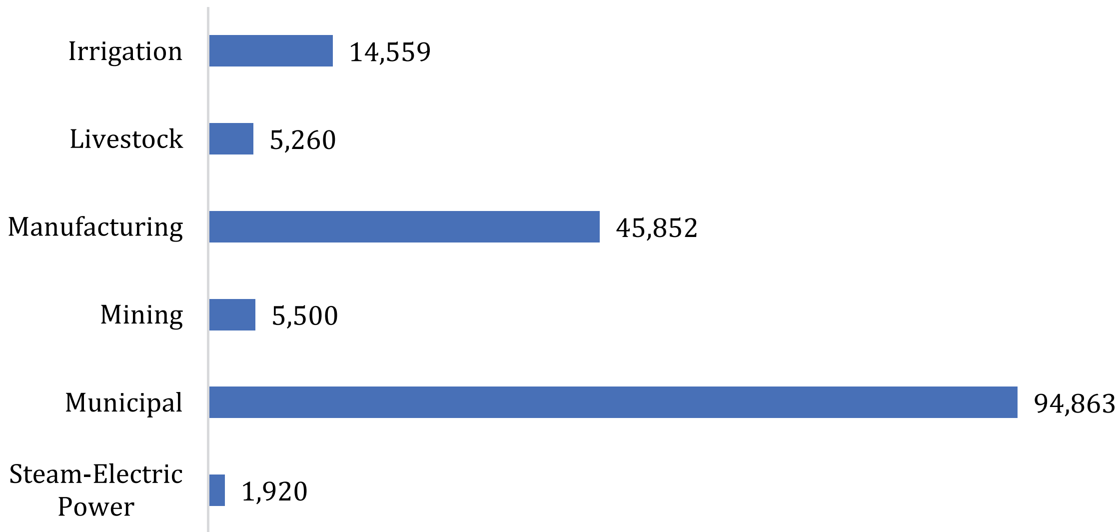
Table 1-1 Region N regional economy by economic sector*

Economic sector	Value-added ($ millions)	Tax ($ millions)	Jobs
Manufacturing	$5,527.5	$180.2	11,243
Public Administration	$4,493.5	$(29.5)	50,696
Construction	$2,830.3	$34.8	31,549
Real Estate and Rental and Leasing	$2,609.3	$421.1	11,361
Mining, Quarrying, and Oil and Gas Extraction	$2,469.4	$459.4	14,661
Health Care and Social Assistance	$2,154.2	$30.3	41,763
Retail Trade	$1,663.8	$418.7	30,644
Wholesale Trade	$1,481.8	$257.4	8,758
Professional, Scientific, and Technical Services	$1,335.4	$30.5	15,716
Utilities	$1,228.0	$138.1	1,628
Accommodation and Food Services	$1,208.5	$193.3	31,166
Other Services (except Public Administration)	$845.2	$87.8	18,484
Finance and Insurance	$774.7	$51.1	12,716
Administrative and Support and Waste Management and Remediation Services	$701.4	$34.4	15,352
Transportation and Warehousing	$691.7	$47.5	10,045
Information	$451.5	$135.3	2,701
Agriculture, Forestry, Fishing and Hunting	$280.4	$9.0	10,630
Management of Companies and Enterprises	$166.3	$4.3	1,524
Arts, Entertainment, and Recreation	$144.2	$30.9	4,848
Educational Services	$55.9	$2.5	2,148
Grand Total	$31,112.9	$2,537.4	327,632

*Source: 2016 IMPLAN for 536 sectors aggregated by 2-digit NAICS (North American Industry Classification System)

While the manufacturing sector led the region in economic output, the majority (56 percent) of water use in 2016 was for municipal use. More than 4 percent of the state's manufacturing water use occurred within Region N. Figure 1-1 illustrates Region N's breakdown of the 2016 water use estimates by TWDB water use category.

Figure 1-1 Region N 2016 water use estimates by water use category (in acre-feet)



Source: TWDB Annual Water Use Estimates (all values in acre-feet)

1.2 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for water user groups (WUG) in Region N with input from the planning group. WUG-level demand projections were established for utilities that provide more than 100 acre-feet of annual water supply, combined rural areas (designated as county-other), and county-wide water demand projections for five non-municipal categories (irrigation, livestock, manufacturing, mining and steam-electric power). The RWPG then compared demands to the existing water supplies of each WUG to determine potential shortages, or needs, by decade.

Table 1-2 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies, are water management strategies that may be recommended by the planning group to address those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population growth, economic growth, or declining supplies. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are also presented in aggregate in Table 1-2. Projected needs for individual water user groups within the aggregate can vary greatly and may reach 100% for a given WUG and water use category. A detailed summary of water needs by WUG and county appears in Chapter 4 of the 2021 Region N Regional Water Plan.

Table 1-2 Regional water needs summary by water use category*

ter Use Category		2020	2030	2040	2050	2060	2070
Irrigation	water needs (acre-feet per year)	1,283	1,474	1,474	1,474	1,474	1,474
	% of the category's total water demand	4%	5%	5%	5%	5%	5%
Livestock	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Manufacturing	water needs (acre-feet per year)	2,286	16,434	21,509	25,741	30,224	34,441
	% of the category's total water demand	3%	17%	22%	26%	31%	35%
Mining	water needs (acre-feet per year)	2,203	2,430	2,327	2,185	2,158	2,216
	% of the category's total water demand	25%	25%	24%	30%	35%	40%
Municipal**	water needs (acre-feet per year)	10,253	10,588	10,786	10,948	11,123	11,250
	% of the category's total water demand	9%	9%	9%	9%	9%	9%
Steam-electric power	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Total water needs (acre-feet per year)		**16,025**	**30,926**	**36,096**	**40,348**	**44,979**	**49,381**

*Entries denoted by a dash (-) indicate no identified water need for a given water use category.
** Municipal category consists of residential and non-residential (commercial and institutional) subcategories.

2 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic and social impacts of potential water shortages during a repeat of the drought of record. Consistent with previous water plans, ten impact measures were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic impact analysis measures

Regional economic impacts	Description
Income losses - value-added	The value of output less the value of intermediate consumption; it is a measure of the contribution to gross domestic product (GDP) made by an individual producer, industry, sector, or group of sectors within a year. Value-added measures used in this report have been adjusted to include the direct, indirect, and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage. These values have been adjusted to include the direct, indirect, and induced employment impacts on the region.
Financial transfer impacts	**Description**
Tax losses on production and imports	Sales and excise taxes not collected due to the shortage, in addition to customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. These values have been adjusted to include the direct, indirect and induced tax impacts on the region.
Water trucking costs	Estimated cost of shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying restricted water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1 Regional Economic Impacts

The two key measures used to assess regional economic impacts are income losses and job losses. The income losses presented consist of the sum of value-added losses and the additional purchase costs of electrical power.

Income Losses - Value-added Losses

Value-added is the value of total output less the value of the intermediate inputs also used in the production of the final product. Value-added is similar to GDP, a familiar measure of the productivity of an economy. The loss of value-added due to water shortages is estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region. The indirect and induced effects are measures of reduced income as well as reduced employee spending for those input sectors which provide resources to the water shortage impacted production sectors.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur and are represented in this analysis by estimated additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employs additional power purchase costs as a proxy for the value-added impacts for the steam-electric power water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it is assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas that occurred during the recent drought period in 2011. This price is assumed to be comparable to those prices which would prevail in the event of another drought of record.

Job Losses

The number of jobs lost due to the economic impact is estimated using IMPLAN output associated with each TWDB water use category. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates are not calculated for the steam-electric power category.

2.2 Financial Transfer Impacts

Several impact measures evaluated in this analysis are presented to provide additional detail concerning potential impacts on a portion of the economy or government. These financial transfer impact measures include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. These measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model is used to estimate reduced tax collections associated with the reduced output in the economy. Impact estimates for this measure include the direct, indirect, and induced impacts for the affected sectors.

Water Trucking Costs

In instances where water shortages for a municipal water user group are estimated by RWPGs to exceed 80 percent of water demands, it is assumed that water would need to be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed, maximum of $35,000[1] per acre-foot of water applied as an economic cost. This water trucking cost was utilized for both the residential and non-residential portions of municipal water needs.

Utility Revenue Losses

Lost utility income is calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates are obtained from utility-specific pricing data provided by the Texas Municipal League, where available, for both water and wastewater. These water rates are applied to the potential water shortage to estimate forgone utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses include estimates of forgone miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

2.3 Social Impacts

Consumer Surplus Losses for Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is

[1] Based on staff survey of water hauling firms and historical data concerning transport costs for potable water in the recent drought in California for this estimate. There are many factors and variables that would determine actual water trucking costs including distance to, cost of water, and length of that drought.

willing and able to pay for a commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. Consumer surplus may also be viewed as an estimate of how much consumers would be willing to pay to keep the original quantity of water which they used prior to the drought. Lost consumer surplus estimates within this analysis only apply to the residential portion of municipal demand, with estimates being made for reduced outdoor and indoor residential use. Lost consumer surplus estimates varied widely by location and degree of water shortage.

Population and School Enrollment Losses

Population loss due to water shortages, as well as the associated decline in school enrollment, are based upon the job loss estimates discussed in Section 2.1. A simplified ratio of job and net population losses are calculated for the state as a whole based on a recent study of how job layoffs impact the labor market population.[2] For every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses are estimated as a proportion of the population lost based upon public school enrollment data from the Texas Education Agency concerning the age K-12 population within the state (approximately 19%).

[2] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015, http://paa2015.princeton.edu/papers/150194. The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model the change in the population as the result of a job layoff event. The study found that layoffs impact both out-migration and in-migration into a region, and that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county.

3 Socioeconomic Impact Assessment Methodology

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate, and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts are based on the overall composition of the economy divided into many underlying economic sectors. Sectors in this analysis refer to one or more of the 536 specific production sectors of the economy designated within IMPLAN, the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 330 of these sectors, with the focus on the more water-intensive production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple, related IMPLAN economic sectors.

3.1 Analysis Context

The context of this socioeconomic impact analysis involves situations where there are physical shortages of groundwater or surface water due to a recurrence of drought of record conditions. Anticipated shortages for specific water users may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

3.2 IMPLAN Model and Data

Input-Output analysis using the IMPLAN software package was the primary means of estimating the value-added, jobs, and tax related impact measures. This analysis employed regional level models to determine key economic impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2016 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value-added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 536 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their appropriate planning water user categories (irrigation, livestock, manufacturing, mining, and municipal). Estimates of value-added for a water use category were obtained by summing value-added estimates across the relevant IMPLAN sectors associated with that water use category. These calculations were also performed for job losses as well as tax losses on production and imports.

The adjusted value-added estimates used as an income measure in this analysis, as well as the job and tax estimates from IMPLAN, include three components:

- ***Direct effects*** representing the initial change in the industry analyzed;
- ***Indirect effects*** that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- ***Induced effects*** that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

Input-output models such as IMPLAN only capture backward linkages and do not include forward linkages in the economy.

3.3 Elasticity of Economic Impacts

The economic impact of a water need is based on the size of the water need relative to the total water demand for each water user group. Smaller water shortages, for example, less than 5 percent, are generally anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage intensifies, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for these characteristics, an elasticity adjustment function is used to estimate impacts for the income, tax and job loss measures. Figure 3-1 illustrates this general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage reaches the lower bound 'b1' (5 percent in Figure 3-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound reaches the 'b2' level shortage (40 percent in Figure 3-1).

To illustrate this, if the total annual value-added for manufacturing in the region was $2 million and the reported annual volume of water used in that industry is 10,000 acre-feet, the estimated economic measure of the water shortage would be $200 per acre-foot. The economic impact of the shortage would then be estimated using this value-added amount as the maximum impact estimate ($200 per acre-foot) applied to the anticipated shortage volume and then adjusted by the elasticity function. Using the sample elasticity function shown in Figure 3-1, an approximately 22 percent shortage in the livestock category would indicate an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments are not required in estimating consumer surplus, utility revenue losses, or utility tax losses. Estimates of lost consumer surplus rely on utility-specific demand curves with the lost consumer surplus estimate calculated based on the relative percentage of the utility's water shortage. Estimated changes in population and school enrollment are indirectly related to the elasticity of job losses.

Assumed values for the lower and upper bounds 'b1' and 'b2' vary by water use category and are presented in Table 3-1.

Figure 3-1 Example economic impact elasticity function (as applied to a single water user's shortage)

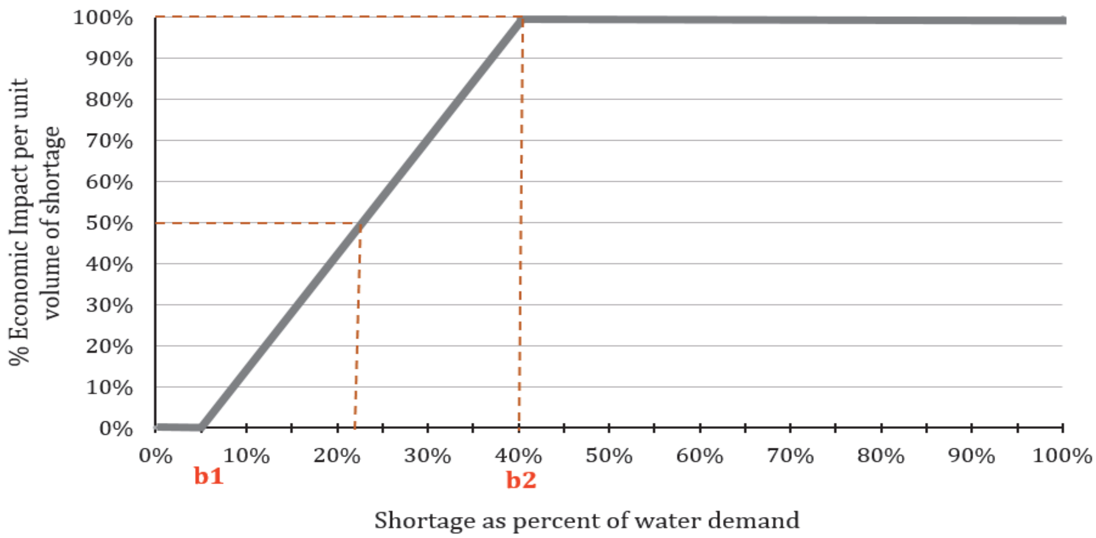


Table 3-1 Economic impact elasticity function lower and upper bounds

Water use category	Lower bound (b1)	Upper bound (b2)
Irrigation	5%	40%
Livestock	5%	10%
Manufacturing	5%	40%
Mining	5%	40%
Municipal (non-residential water intensive subcategory)	5%	40%
Steam-electric power	N/A	N/A

3.4 Analysis Assumptions and Limitations

The modeling of complex systems requires making many assumptions and acknowledging the model's uncertainty and limitations. This is particularly true when attempting to estimate a wide range of socioeconomic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of this methodology include:

1. The foundation for estimating the socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified by RWPGs as part of the

regional water planning process. These needs have some uncertainty associated with them but serve as a reasonable basis for evaluating the potential impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshots for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct “what if” scenarios for each particular year, and water shortages are assumed to be temporary events resulting from a single year recurrence of drought of record conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, availability of limited resources, and other structural changes to the economy that may occur in the future. Changes in water use efficiency will undoubtedly take place in the future as supplies become more stressed. Use of the static IMPLAN structure was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This is not a form of cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting methods to weigh future costs differently through time.

5. All monetary values originally based upon year 2016 IMPLAN and other sources are reported in constant year 2018 dollars to be consistent with the water management strategy requirements in the State Water Plan.

6. IMPLAN based loss estimates (income-value-added, jobs, and taxes on production and imports) are calculated only for those IMPLAN sectors for which the TWDB’s Water Use Survey (WUS) data was available and deemed reliable. Every effort is made in the annual WUS effort to capture all relevant firms who are significant water users. Lack of response to the WUS, or omission of relevant firms, impacts the loss estimates.

7. Impacts are annual estimates. The socioeconomic analysis does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

8. Value-added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two measures (value-added and consumer surplus) are both valid impacts but ideally should not be summed.

9. The value-added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects to capture backward linkages in the economy described in Section 2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

10. The majority of impacts estimated in this analysis may be more conservative (i.e., smaller) than those that might actually occur under drought of record conditions due to not including impacts in the forward linkages in the economy. Input-output models such as IMPLAN only capture backward linkages on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in this type of economic modeling effort, it is important to note that forward linkages on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, resulting in conservative impact estimates.

11. The model does not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to some industries immediately following a drought, such as landscaping;
    b. The cost and time to rebuild liquidated livestock herds (a major capital investment in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not necessarily reflect what might occur on a statewide basis.

13. **The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers.** Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

14. The methodology does not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

15. The methodology that the TWDB has developed for estimating the economic impacts of unmet water needs, and the assumptions and models used in the analysis, are specifically designed to estimate potential economic effects at the regional and county levels. Although it may be tempting to add the regional impacts together in an effort to produce a statewide result, the TWDB cautions against that approach for a number of reasons. The IMPLAN modeling (and corresponding economic multipliers) are all derived from regional models – a statewide model of Texas would produce somewhat different multipliers. As noted in point 14 within this section, the regional modeling used by TWDB does not capture spillover losses that could result in other regions from unmet needs in the region analyzed, or potential spillover gains if decreased production in one region leads to increases in production elsewhere. The assumed drought of record may also not occur in every region of Texas at the same time, or to the same degree.

4 Analysis Results

This section presents estimates of potential economic impacts that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented. Projected economic impacts for the six water use categories (irrigation, livestock, manufacturing, mining, municipal, and steam-electric power) are reported by decade.

4.1 Impacts for Irrigation Water Shortages

Five of the 11 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-1. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. However, it was not considered realistic to report increasing tax revenues during a drought of record.

Table 4-1 Impacts of water shortages on irrigation in Region N

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$0	$0	$0	$0	$0	$0
Job losses	7	11	11	11	11	11

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.2 Impacts for Livestock Water Shortages

None of the 11 counties in the region are projected to experience water shortages in the livestock water use category. Estimated impacts to this water use category appear in Table 4-2.

Table 4-2 Impacts of water shortages on livestock in Region N

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$-	$-	$-	$-	$-	$-
Jobs losses	-	-	-	-	-	-
Tax losses on production and imports ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.3 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in five of the 11 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 4-3.

Table 4-3 Impacts of water shortages on manufacturing in Region N

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$9	$1,144	$2,428	$3,949	$5,291	$6,185
Job losses	54	7,375	16,152	26,550	35,719	41,825
Tax losses on production and Imports ($ millions)*	$1	$85	$177	$287	$384	$449

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.4 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in eight of the 11 counties for one or more decades within the planning horizon. Estimated impacts to this water use type appear in Table 4-4.

Table 4-4 Impacts of water shortages on mining in Region N

Income losses ($ millions)*	$608	$669	$632	$592	$584	$604
Job losses	3,675	4,021	3,743	3,430	3,310	3,349
Tax losses on production and Imports ($ millions)*	$67	$74	$70	$66	$65	$68

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.5 Impacts for Municipal Water Shortages

Six of the 11 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon.

Impact estimates were made for two sub-categories within municipal water use: residential and non-residential. Non-residential municipal water use includes commercial and institutional users, which are further divided into non-water-intensive and water-intensive subsectors including car wash, laundry, hospitality, health care, recreation, and education. Lost consumer surplus estimates were made only for needs in the residential portion of municipal water use. Available IMPLAN and TWDB Water Use Survey data for the non-residential, water-intensive portion of municipal demand allowed these sectors to be included in income, jobs, and tax loss impact estimate.

Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed, maximum cost of $35,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 4-5.

Table 4-5 Impacts of water shortages on municipal water users in Region N

Income losses[1] ($ millions)*	$114	$117	$118	$120	$123	$125
Job losses[1]	2,219	2,279	2,302	2,333	2,388	2,428
Tax losses on production and imports[1] ($ millions)*	$11	$12	$12	$12	$12	$13
Trucking costs ($ millions)*	$48	$50	$50	$51	$52	$52
Utility revenue losses ($ millions)*	$29	$30	$31	$31	$32	$32
Utility tax revenue losses ($ millions)*	$1	$1	$1	$1	$1	$1

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.6 Impacts of Steam-Electric Water Shortages

None of the 11 counties in the region are projected to experience water shortages in the steam-electric water use category. Estimated impacts to this water use category appear in Table 4-6.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of estimated additional purchasing costs for power from the electrical grid to replace power that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Do not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 4-6 Impacts of water shortages on steam-electric power in Region N

Income Losses ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.7 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 4-7.

Table 4-7 Region-wide social impacts of water shortages in Region N

Consumer surplus losses ($ millions)*	$158	$163	$166	$168	$171	$172
Population losses	1,093	2,513	4,077	5,935	7,606	8,742
School enrollment losses	209	481	780	1,135	1,455	1,672

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

Appendix A - County Level Summary of Estimated Economic Impacts for Region N

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2018 dollars, rounded). Values are presented only for counties with projected economic impacts for at least one decade.
(* Entries denoted by a dash (-) indicate no estimated economic impact)

		Income losses (Million $)*						Job losses					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
BEE	IRRIGATION	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	1	1	1	1	1	1
BEE	MINING	$62.11	$58.32	$45.42	$23.86	$13.07	$8.10	371	348	271	143	78	48
BEE	MUNICIPAL	$11.44	$12.80	$12.87	$12.62	$13.39	$13.43	222	248	250	245	258	259
BEE Total		**$73.58**	**$71.15**	**$58.31**	**$36.50**	**$26.49**	**$21.55**	**593**	**597**	**522**	**388**	**337**	**308**
BROOKS	MINING	$160.60	$163.29	$145.34	$130.99	$116.63	$107.66	691	703	626	564	502	463
BROOKS	MUNICIPAL	$2.03	$2.26	$2.51	$2.80	$3.09	$3.27	40	44	49	55	60	64
BROOKS Total		**$162.63**	**$165.55**	**$147.85**	**$133.79**	**$119.72**	**$110.93**	**731**	**747**	**675**	**618**	**562**	**527**
DUVAL	MINING	$75.96	$81.93	$72.12	$60.28	$52.17	$44.05	906	977	860	719	622	526
DUVAL	MUNICIPAL	$7.40	$7.87	$8.28	$8.78	$9.33	$9.83	144	153	161	171	182	191
DUVAL Total		**$83.36**	**$89.81**	**$80.40**	**$69.05**	**$61.50**	**$53.88**	**1,050**	**1,131**	**1,022**	**890**	**804**	**717**
JIM WELLS	IRRIGATION	$0.14	$0.14	$0.14	$0.14	$0.14	$0.14	4	4	4	4	4	4
JIM WELLS	MANUFACTURING	-	$5.77	$5.77	$5.77	$5.77	$5.77	-	21	21	21	21	21
JIM WELLS	MINING	$26.85	$28.40	$18.59	$10.84	$2.26	$0.01	174	184	121	70	15	0
JIM WELLS	MUNICIPAL	$21.77	$22.89	$23.97	$25.33	$26.71	$28.03	424	446	467	494	520	546
JIM WELLS Total		**$48.76**	**$57.20**	**$48.46**	**$42.08**	**$34.88**	**$33.95**	**602**	**655**	**612**	**589**	**560**	**571**
KENEDY	MINING	$10.25	$11.13	$4.81	$0.27	-	-	49	53	23	1	-	-
KENEDY Total		**$10.25**	**$11.13**	**$4.81**	**$0.27**	**-**	**-**	**49**	**53**	**23**	**1**	**-**	**-**
KLEBERG	MANUFACTURING	-	$52.71	$52.71	$52.71	$52.71	$52.71	-	193	193	193	193	193
KLEBERG	MINING	$14.38	$14.91	$11.48	$8.96	$6.64	$5.33	172	178	137	107	79	64
KLEBERG Total		**$14.38**	**$67.62**	**$64.19**	**$61.67**	**$59.36**	**$58.04**	**172**	**371**	**330**	**300**	**272**	**257**
LIVE OAK	IRRIGATION	$0.08	$0.21	$0.21	$0.21	$0.21	$0.21	2	6	6	6	6	6
LIVE OAK Total		**$0.08**	**$0.21**	**$0.21**	**$0.21**	**$0.21**	**$0.21**	**2**	**6**	**6**	**6**	**6**	**6**

	Income losses (Million $)*						Job losses					
		$54.30	$60.61	$65.62	$72.94			473	528	571	635	
		$71.25	$70.59	$70.27	$70.22			1,388	1,375	1,369	1,368	
		$256.60	$273.64	$291.59	$320.30			1,105	1,178	1,255	1,379	

Appendix C

Technical Memorandum

[TWDB contract]

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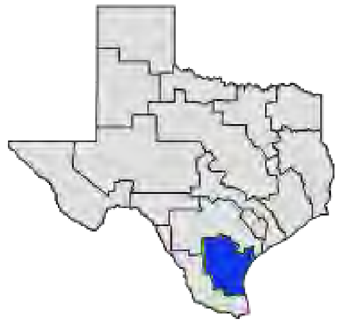

2021 Coastal Bend Region N – Regional Water Plan

TECHNICAL MEMORANDUM

Coastal Bend Region, Texas

September 10, 2018

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2021 Coastal Bend (Region N) Regional Water Plan

Technical Memorandum

September 2018

STATE OF TEXAS
KRISTINE S. SHAW
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LICENSED
PROFESSIONAL ENGINEER

9/10/18

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Figures

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In accordance with the Texas Administrative Code §357.12(c) and Section 13.1.1 of the Second Amended General Guidelines for Regional Water Plan Development, the Coastal Bend (Region N) Regional Water Planning Group submits this technical memorandum for consideration by the TWDB. This technical memorandum presents population and water demand projections, source water availability, existing water supplies, preliminary water needs, Region N's adopted process for identifying potentially feasible water management strategies, list of potentially feasible water management strategies to date, and Region N's response regarding TWDB's simplified planning option. The appendix includes the nine-DB22 reports requested by the TWDB for inclusion in the technical memorandum. The contents of this technical memorandum were approved at Region N's public meeting on August 9, 2018 that included the 14 day notice and public comment period which closed two weeks after the meeting, on August 23, 2018.

1 DB22 Reports

The following DB22 reports are provided in Appendix A of this document.

- Report # 1- WUG Population Projections
- Report # 2- WUG Water Demand Projections
- Report # 3- WUG Category Summary
- Report # 4- Source Water Availability
- Report # 5- WUG Existing Water Supplies
- Report # 6- WUG Identified Water Needs/ Surpluses
- Report # 9- Source Water Balance
- Report #10a- WUG Data Comparison to 2016 RWP
- Report #10b- Source Data Comparison to 2016 RWP

2 Population and Water Demand Projections Adopted by the TWDB for Development of the 2021 Region N Plan and 2022 State Water Plan

On December 22, 2016, the TWDB provided draft population, municipal and mining water demand projections to Region N for consideration in development of the 2021 Coastal Bend (Region N) Regional Water Plan. For the 2021 Regional Water Planning cycle, no new census data was available and county-wide population totals were the same as those in the 2016 Region N Plan/2017 State Water Plan. A key difference with this new planning cycle is that the 2017 State Water Plan population and municipal demands are transitioned from political boundaries to utility service areas for development of the 2021 Regional Water Plan. At the Region N meeting on January 16, 2017, a subcommittee was appointed to review draft TWDB population, municipal water demand projections, and mining water demand projections and provide a recommendation to the Region N planning group. On April 6, 2017, the subcommittee met to review these TWDB draft projections and recommended modifications for Nueces WSC based on utility-provided information. The subcommittee recommended approving the draft TWDB mining water demand projections and all other population and municipal water demand projections provided by the TWDB. Alternate population and water demand projections were prepared for Nueces WSC that were subsequently considered and adopted at the Region N meeting on August 10, 2017.

On June 2, 2017 the TWDB provided draft non-municipal water demand projections (steam-electric, manufacturing, livestock, and irrigation) for Region N Water Planning Group review and comment. A Region N subcommittee comprised of six Region N members was formed at the August 10, 2017 RWPG meeting to review TWDB draft steam electric, manufacturing, livestock, and irrigation water demand projections. The subcommittee met on September 7, 2017 to discuss TWDB draft projections and local data pertinent to demand projections. At the subcommittee's request, based on local feedback and data, alternative demand projections were prepared for Nueces and San Patricio County- manufacturing users and all counties with projected irrigation water demands. These alternate projections were considered and adopted by Region N at its November 9, 2017 meeting. The Nueces River Authority, administrator for Region N, submitted a letter to the TWDB requesting consideration of Region N's adopted alternate projections for Nueces WSC, Nueces County-Manufacturing, San Patricio County- Manufacturing, and irrigation users by the January 12, 2018 request submittal deadline. The TWDB approved the projections in April 2018.

Table 2-1 shows the Region N population projections by county. Table 2-2 shows total water demand projections, by county. Table 2-3 shows the breakdown of Region N water demand projections by use category. Figure 1 shows a comparison of water demand projections from the 2021 Region N Plan to previous 2016 Region N Plan/ 2017 State Water Plan projections. For the 2021 Region N Plan, municipal projections increased by about 3%. Irrigation increased for Year 2020, but then decreased for subsequent decades as compared to the 2016 Region N Plan estimates. Manufacturing, steam-electric, and livestock projections for the 2021 Region N Plan are all lower than those from the 2016 Region N Plan/2017 State Water Plan. The largest reduction is in steam-electric projections ranging from 11,042 to 30,545 acre-feet per year (ac-ft/yr) lower for the 2021 Region N Plan as compared to the previous planning cycle.

Table 2-1. Region N Population Projections by County

County Name	2020	2030	2040	2050	2060	2070
ARANSAS	24,463	24,991	24,937	25,102	25,103	25,104
BEE	33,478	34,879	35,487	35,545	35,579	35,590
BROOKS	7,783	8,252	8,722	9,181	9,595	9,979
DUVAL	12,715	13,470	14,098	14,644	15,080	15,435
JIM WELLS	44,987	48,690	52,052	55,533	58,600	61,410
KENEDY	463	498	504	507	508	508
KLEBERG	35,567	38,963	42,202	45,324	48,251	50,989
LIVE OAK	11,683	11,690	11,690	11,690	11,690	11,690

Table 2-1. Region N Population Projections by County

MCMULLEN	734	734	734	734	734	734
NUECES	374,157	407,534	428,513	440,797	449,936	456,056
SAN PATRICIO	68,760	72,114	74,043	75,451	76,405	77,049
Region N Total	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**

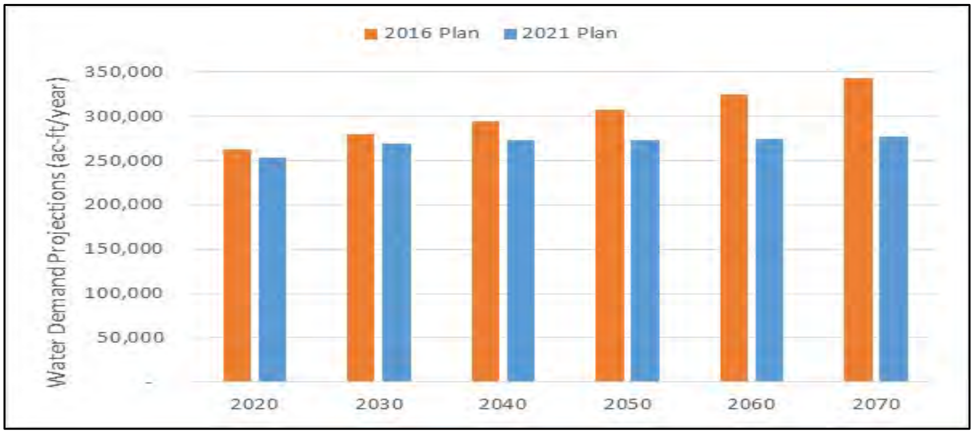
Table 2-2. Region N Water Demand Projections by County (ac-ft/yr)

County Name						
ARANSAS	4,151	4,143	4,060	4,048	4,040	4,040
BEE	12,170	12,270	12,234	12,137	12,093	12,074
BROOKS	3,845	3,899	3,937	3,991	4,047	4,116
DUVAL	8,241	8,362	8,325	8,276	8,267	8,263
JIM WELLS	11,044	11,508	11,908	12,409	12,896	13,361
KENEDY	1,097	1,118	1,089	1,066	1,041	1,025
KLEBERG	9,098	9,683	9,997	10,360	10,744	11,118
LIVE OAK	7,274	7,550	7,503	7,308	7,058	6,898
MCMULLEN	4,919	5,482	5,429	3,295	2,523	1,978
NUECES	124,951	134,710	137,462	139,157	140,845	142,120
SAN PATRICIO	66,428	71,041	71,118	71,230	71,371	71,499
Region N Total	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**

Table 2-3. Region N Water Demand Projections by Category (ac-ft/yr)

Municipal	115,366	121,198	124,655	127,324	130,021	132,248
Manufacturing	88,634	98,480	98,480	98,480	98,480	98,480
Irrigation	30,206	30,206	30,206	30,206	30,206	30,206
Mining	8,951	9,821	9,660	7,206	6,157	5,497
Livestock	6,065	6,065	6,065	6,065	6,065	6,065
Steam-Electric	3,996	3,996	3,996	3,996	3,996	3,996
Region N Total	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**

Figure 2-1. Comparison of Region N Water Demand Projections from 2021 Plan and Previous 2016 Plan, Combined Demands for all Use Types



3 Source Water Availability

3.1 Surface water availability

The TWDB guidelines[1] state that planning groups must use firm yield and TCEQ WAM Run 3 for determining current and future water supplies unless a hydrologic variance request is approved by the TWDB Executive Administrator for variations from the standard modeling requirements.

At the Region N meeting on August 10, 2017, Region N discussed the TCEQ WAMs relevant to surface water supplies in the region and the City of Corpus Christi Water Supply Model (formerly NUBAY model). In 1990, the City of Corpus Christi developed the Lower Nueces River Basin and Estuary Model (NUBAY) to evaluate its multi-basin regional water supply system subject to environmental flow provisions and reservoir operating policies. Since then, the City and other public agencies have supported enhancements and updates to the NUBAY model, which has been renamed the City of Corpus Christi Water Supply Model. The previous Region N Plans (2006, 2011, and 2016) used the Corpus Christi Water Supply Model to evaluate water availability, with safe yield as a basis for developing water planning and needs analysis for the City of Corpus Christi and its customers. The Corpus Christi Regional Water Supply System, simulated by the Corpus Christi Water Supply Model, includes the City's contracted and/or permitted water rights from Choke Canyon Reservoir, Lake Corpus Christi, Lake Texana, and the Lower Colorado River.

In 2017, the Corpus Christi Water Supply Model was updated to include:

- Recent hydrology through 2015 to include the most recent drought of record for a total model period of 82 years (1934 to 2015), including extensions to net evaporation and ungaged runoff below LCC for recent hydrology using methods consistent with previous model version (1934 to 2003);
- New TWDB volumetric survey data for Lake Corpus Christi (2016), Choke Canyon Reservoir (2012), and Lake Texana (2010) with updated sedimentation rates;

[1] First Amended General Guidelines for Fifth Cycle of Regional Water Plan Development, April 2017.

- Recent hydrology for Lake Texana and the Colorado River (for Mary Rhodes Phase II supplies) through 2015;
- Lake Texana callback of 5,400 ac-ft/yr as exercised by LNRA for local water users in Jackson County pursuant to City of Corpus Christi contract terms; and
- Verification that all enhancements maintain the provisions of the TCEQ 2001 Agreed Order.

The Region N planning group does not consider the TCEQ Nueces Basin WAM Run 3 to be the best model to simulate the Corpus Christi Regional Water Supply System operation policy subject to permits nor does it reflect all aspects of the TCEQ 2001 Agreed Order. Furthermore, the hydrology ends in 1996 and doesn't cover the recent drought of record.

At the August 10, 2017 Region N meeting, the planning group also considered TWDB's guidance to use firm yield when determining surface water availability. The City's regional water supply system is prone to severe drought. Average annual inflows to Lake Corpus Christi and Choke Canyon System are lower with each successive drought, with the most recent hydrology update to the Corpus Christi Water Supply Model (through 2015) showing a *new* drought of record for the Corpus Christi Regional Water Supply System. Safe yield is a standard approach that Region N and the City of Corpus Christi have consistently used in previous planning cycles as a provision for climate and growth uncertainty, such that a *specified reserve amount remains* in storage during the modeled critical drought. Based on a presentation by the City of Corpus Christi and additional information, Region N approved submittal of a hydrologic variance request to use safe yield for determining surface water supplies available to the City's Regional Water Supply System for 2021 Plan development.

At the request of Region N, two hydrologic variance requests were submitted to the TWDB on September 22, 2017 requesting (1) use of the Corpus Christi Water Supply Model for determining surface water availability for the Corpus Christi Regional Water Supply System and approval to report water availability for the multi-basin regional supply as a system rather than individual reservoirs and (2) use of safe yield as the basis for determining availability for the Corpus Christi Regional Water Supply System. Region N's approved safe yield approach is based on maintaining a 75,000 ac-ft reserve in storage during the worst, historical drought of record.

Region N received a hydrologic variance from the TWDB on January 5, 2018 approving use of the following approach for determining surface water availability and existing supply for the Corpus Christi Regional Water Supply System to include (a) operating as a reservoir system; (b) determining availability using the Corpus Christi Water Supply Model, which covers an 81 year hydrologic period from 1934-2015; and (c) planning for a safe yield reserve (buffer) of 75,000 acre-feet to remain in the CCR/LCC reservoir system during the drought of record conditions to account for future drought uncertainty.

Surface water availability for all other surface water rights, including run of the river rights, is based on WAM Run 3. Pursuant to TWDB guidance "Run of river availability, or firm diversion, evaluated for a municipal sole-source water use, is defined as the minimum monthly diversion amount that is available 100% of the time during a repeat of the drought of record (i.e., this minimum volume must be available each and every month)." HDR coordinated with Region L's consultant for consistency in modeling upstream Nueces Basin water rights that could have an impact on Lower Nueces Basin rights located within Region N.

Table 3-1 presents surface water supplies available to Region N, including firm yield for entities where hydrologic variances were approved to use safe yield, per TWDB requirements. For surface water withdrawals that do not require permits, such as for livestock purposes, Region N estimated local annual water availability volumes under drought of record conditions based on current water use data provided by the TWDB. The City of Corpus Christi is currently evaluating infrastructure constraints and requests received for contract modifications. Region N will use information provided by the City to confirm water contracts and infrastructure constraints for the City of Corpus Christi and their customers. This may constrain existing surface water supplies and result in supplies from the Corpus Christi Regional Water Supply System being lower than the availability shown in Table 3-1.

Table 3-1. Surface Water Supplies Available to Region N (Not limited by infrastructure)

Corpus Christi Regional Water Supply System [1]	City of Corpus Christi and its direct/indirect customers	Yes	Corpus Christi Water Supply Model[2]	Safe Yield- 75,000 acft reserve	178,000	175,700	173,500	171,300	169,000	166,800
Nueces-Run of the River	Nueces County WCID #3[3]	No	TCEQ Nueces WAM	Firm Yield	384	384	384	384	384	384
Nueces-Run of the River	City of Three Rivers[4]	No	TCEQ Nueces WAM	Firm Yield	1,500	1,500	1,500	1,500	1,500	1,500
Other Local Supply	Nueces County-Livestock	No	N/A	Firm Yield	50	50	50	50	50	50

N/A- Not applicable.
[1]Firm yield for the Corpus Christi Regional Water Supply System is as follows: 194,100 ac-ft/yr (2020); 191,900 ac-ft/yr (2030); 189,600 ac-ft/yr (2040); 187,300 ac-ft/yr (2050); 185,000 ac-ft/yr (2060); and 182,700 ac-ft/yr (2070).
[2]See details on model modification assumptions, described in Section 3.1 main body text.
[3]Subject to Nueces County WCID # 3's Certificate of Adjudication provisions for No. 2466, 1909+ priority, no storage.
[4]Subject to City of Three River's Certificate of Adjudication provisions for No. 3215, 1914 priority, storage 2,500 acft.

The following models were used to develop surface water availabilities for the 2021 Region N Plan.

- Corpus Christi Water Supply Model
- TCEQ Nueces Basin Water Availability Model

Details of the model runs performed to determine surface water availability are included in Table 3-2.

Table 3-2. WAM Models Used in Determining Surface Water Availability in Region N

Name of Model	Model Use/Entities Served	Date Modifications were Approved by TWDB	Run Performed by	Date of Model Run	Model Inputs/Output Files Used	Comments
Corpus Christi Water Supply Model	Corpus Christi Regional Water Supply System	January 5, 2018	HDR	8/3/2017	/2020_FY/ and /2070_FY/ OSUM; OASYSOP OCCR; OLCC OQEST; OQM OSALTTRC; OSYSOP OTEX; OTEXOP OTRACE; OWQ OBAY; OBBEST DAIYP; ADDSOUR	2020 and 2070- Firm Yield
					/2020_SY_75/ and /2070_SY_75/ OSUM; OASYSOP OCCR; OLCC OQEST; OQM OSALTTRC; OSYSOP OTEX; OTEXOP OTRACE; OWQ OBAY; OBBEST DAIYP; ADDSOUR	2020 and 2070- Safe Yield
TCEQ Nueces WAM- Run 3	Run of the River Right Holders, including NCWCID # 3 and City of Three Rivers	Not Applicable	HDR	5/3/2018	/2020/ and /2070/ N_RUN3.DAT N_RUN3.DIS N_RUN3.EVA N_RUN3.flo N_RUN3.out (Note: to minimize file size, output file not included in CD)	2020 and 2070- Firm Yield

3.2 Groundwater Availability

Three groundwater management areas (GMAs) are represented within the Region N 11-county area: GMA 13, GMA 15, and GMA 16. All three of these GMAs adopted new desired future conditions (DFCs) between April 2016 and January 2017, as summarized in Table 3-3. These DFCs were then used by the TWDB to develop Modeled Available Groundwater estimates (MAGs) for use in development of the 2021 Region N Regional Water Plan. A summary of the MAGs and associated TWDB model run and date of TWDB model simulation from which the MAGs originated is included in Table 3-4. These MAG projections based on GMA-approved desired future conditions were discussed at Region N's meeting on November 9, 2017 and confirmed to serve as the basis of groundwater availability in the 2021 Region N Plan.

Table 3-3. Desired Future Conditions Adopted by GMAs in Region N

Aquifer	Desired Future Condition
GMA 13 (Date DFC Adopted 11/21/2016)	
Carrizo-Wilcox, Queen City, and Sparta Aquifer System	Average drawdown of 48 feet for all of GMA 13 calculated from the end of 2012 conditions to the year 2070
GMA 15 (Date DFC Adopted 4/29/2016)	
Aransas Gulf Coast Aquifer System	0 feet of drawdown of the Gulf Coast Aquifer System
Bee Gulf Coast Aquifer System	7 feet of drawdown of the Gulf Coast Aquifer System
GMA 16 (Date DFC Adopted 1/17/2017)	
Bee GCD Gulf Coast Aquifer System	76 feet of drawdown of the Gulf Coast Aquifer System
Live Oak UWCD Gulf Coast Aquifer System	34 feet of drawdown of the Gulf Coast Aquifer System
McMullen GCD Gulf Coast Aquifer System	9 feet of drawdown of the Gulf Coast Aquifer System
Kenedy County GCD Gulf Coast Aquifer System	40 feet of drawdown of the Gulf Coast Aquifer System
Brush Country GCD Gulf Coast Aquifer System	69 feet of drawdown of the Gulf Coast Aquifer System
Duval County GCD Gulf Coast Aquifer System	104 feet of drawdown of the Gulf Coast Aquifer System
San Patricio County GCD Gulf Coast Aquifer System	48 feet of drawdown of the Gulf Coast Aquifer System
Non-District Kleberg Gulf Coast Aquifer System	28 feet of drawdown of the Gulf Coast Aquifer System
Non-District Nueces Gulf Coast Aquifer System	21 feet of drawdown of the Gulf Coast Aquifer System

Table 3-4. Modeled Available Groundwater Values and Details on Related TWDB Model Runs

GMA 13 (Model Run: GR17-027 MAG, dated 10/27/2017)									
Carrizo-Wilcox	McMullen	N	Nueces	7,056	7,056	4,405	4,405	4,405	4,405
Queen City	McMullen	N	Nueces	134	134	134	134	134	134
Sparta	McMullen	N	Nueces	89	89	89	89	89	89
GMA 15 (Model Run: GR16-025 MAG, dated 3/22/2017)									
Gulf Coast	Aransas	N	San Antonio-Nueces	1,542	1,542	1,542	1,542	1,542	1,542
Gulf Coast	Bee	N	San Antonio-Nueces	9,439	9,414	9,414	9,362	9,362	9,362
Gulf Coast	Bee	N	Nueces	27	27	27	27	27	27
GMA 16 (Model Run: GR17-025 MAG, dated 5/19/2017)									
Gulf Coast	Bee	N	Nueces	770	893	949	978	995	995
Gulf Coast	Bee	N	San Antonio-Nueces	8,201	9,503	10,112	10,414	10,589	10,589
Gulf Coast	Brooks	N	Nueces-Rio	5,582	6,352	7,122	7,892	7,892	7,892
Gulf Coast	Duval	N	Nueces	326	351	376	401	428	428
Gulf Coast	Duval	N	Nueces-Rio	20,245	21,818	23,388	24,962	26,535	26,535
Gulf Coast	Jim Wells	N	Nueces	593	593	593	593	593	593
Gulf Coast	Jim Wells	N	Nueces-Rio	8,551	9,090	9,593	10,132	10,424	10,424
Gulf Coast	Kenedy	N	Nueces-Rio	13,301	18,621	23,941	29,261	29,261	29,261
Gulf Coast	Kleberg	N	Nueces-Rio	10,365	13,082	15,800	18,518	18,711	18,711
Gulf Coast	Live Oak	N	Nueces	8,297	9,297	8,522	8,400	8,400	8,400
Gulf Coast	Live Oak	N	San Antonio-Nueces	41	46	42	41	41	41
Gulf Coast	McMullen	N	Nueces	510	510	510	510	510	510
Gulf Coast	Nueces	N	Nueces-Rio	5,862	6,191	6,522	6,851	7,079	7,079

Table 3-4. Modeled Available Groundwater Values and Details on Related TWDB Model Runs

Aquifer	County	Region	River Basin	Modeled Available Groundwater (ac ft/yr)					
				2020	2030	2040	2050	2060	2070
Gulf Coast	Nueces	N	Nueces	727	756	787	816	845	845
Gulf Coast	Nueces	N	San Antonio-Nueces	0	0	0	0	0	0
Gulf Coast	San Patricio	N	Nueces	4,130	4,502	4,874	5,247	5,619	5,619
Gulf Coast	San Patricio	N	San Antonio-Nueces	39,481	40,514	41,548	42,581	43,615	43,615
Total MAG (acft/yr)				**145,269**	**160,381**	**170,290**	**183,156**	**187,096**	**187,096**
Gulf Coast MAG (acft/yr)				***137,990***	***153,102***	***165,662***	***178,528***	***182,468***	***182,468***

Note: *Year 2070 set equal to Year 2060 for GMA 15 and GMA 16 MAGs.*

Region N did not perform any independent analyses using groundwater availability models (GAM) to estimate groundwater availability, nor were any alternative methods utilized by Region N to estimate groundwater availabilities.

Groundwater supplies in the 2021 Region N Water Plan are based on MAG projections provided by the TWDB, constrained by well capacity as reported in TCEQ PWS database. For non-municipal groundwater users with groundwater capacities that are not readily obtained from publicly available sources, the groundwater supply was calculated based on TWDB historical water use records. The final step in determining groundwater supplies was to compare the MAG-preserved well capacities to projected demands for each WUG that has historically relied on groundwater. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower.

For water user groups that use both groundwater and surface water supplies, it was generally assumed that the water user group would use groundwater up to its well capacity (limited by MAG) and then use available surface water per rights or contracts to total the projected water demand through combination of groundwater and surface water supplies. However, for South Texas Water Authority (STWA) customers that rely on both surface and groundwater supplies, surface water supplies were allocated based on historical water use records provided by STWA accounting for modest growth subject to surface water availability, with the remaining water supplies provided by groundwater up to water demand subject to MAG and capacity constraints. Region N assumes that excess groundwater beyond demands would not be pumped and therefore would be available as a collective resource for future water management strategy development subject to adopted MAGs.

With new rule changes since development of the 2016 Regional Water Plans, the TWDB allows the regional water planning groups to utilize a MAG peak factor for determining groundwater availability, if needed. Region N discussed MAG peak factors at its November 9, 2017 meeting and appointed a subcommittee for additional discussion. TWDB guidance and materials for determining whether or not to exercise the option of using MAG peak factors was reviewed by the Region N subcommittee on February 28, 2018 and considered when preparing their recommendation. At Region N's May 10, 2018 meeting, Region N accepted the subcommittee's recommendation not to utilize the MAG peak factor option for any counties in Region N.

3.3 Reuse

Water availability from current reuse projects was updated and set equal to the maximum reported historical reuse amount over a recent five year period (2010-2015) reported in TWDB's water use database.

Table 3-5. Current Reuse Supplies Available in Region N

County	Entity Using the Source	Water availability (ac ft/yr)					
		2020	2030	2040	2050	2060	2070
Nueces	Nueces County Manufacturing	1,140	1,140	1,140	1,140	1,140	1,140
San Patricio	San Patricio County Manufacturing	448	448	448	448	448	448

4 Identified Water Needs and Surpluses

A copy of the needs analysis resulting from the water demand and supply analysis described in previous Sections 2 and 3, is provided in Appendix A- Report # 6- WUG Identified Water Needs/ Surpluses.

5 Process used by the Coastal Bend Regional Water Planning Group to Identify Potentially Feasible Water Management Strategies

During Region N's meeting on August 10, 2017, the planning group discussed water management strategies evaluated during previous Region N Plans and the 24 types of water management strategies shown in Table 5-1 that regional water planning groups are advised to consider for identified water needs as provided in TWDB guidance[2] and as required by Texas Water Code §16.053(e)(3) and 31 Texas Administrative Code §357.34(c).

[2]Section 5.1 of the First Amended General Guidelines for Fifth Cycle of Regional Water Plan Development, Exhibit C, April 2017.

Table 5-1. Types of Potentially Feasible Water Management Strategies Considered by Region N, per Statutory Guidance

• Conservation	• Interbasin Transfers
• Drought Management	• System Optimization
• Reuse	• Reallocation of Reservoir Storage to New Uses
• Management of Existing Supplies	• Yield Enhancement
• Conjunctive Use	• Water Quality Improvements
• Acquisition of Available Existing Supplies	• New Surface Water Supply
• New Water Supplies	• New Groundwater Supply
• Regional Water Supply Facilities	• Brush Control
• Desalination- Seawater or Brackish Groundwater	• Precipitation Enhancement
• Desalination - Marine	• Aquifer Storage and Recovery
• Voluntary Transfers within a region	• Cancellation of Water Rights
• Emergency Transfers	• Rainwater Harvesting

Region N adopted the following process to identify potentially feasible water management strategies at its meeting on August 10, 2017:

- Consider recommended and considered water management strategies (WMS) from previous Region N Plans (2001, 2006, 2011, and 2016)
- Outreach to WWPs and WUGs and gather feedback on local, on-going studies and future water plans
- Preparation of draft list of potentially feasible water management strategies
- Scope of work subcommittee to review list and TWDB allocation for WMS evaluations. Prepare recommendation for Region N consideration, including draft scope of work for comment and feedback.
- Coordination with WWPs/WUGs to confirm list of WMSs, including classifying as recommended, alternative or rejected
- Prepare draft list of potentially feasible water management strategies for public comment
- Refine lists to meet WUG needs for inclusion in Technical Memorandum, Initially Prepared Plan, and Final Plan

6 List of Potentially Feasible WMSs Identified by the Coastal Bend Regional Water Planning Group

At the May 10, 2018 Region N meeting, a draft list of potentially feasibility water management strategies (WMSs) for the 2021 Plan was discussed. The list included previous strategies evaluated in the 2016 Plan, consideration of the types of water management strategies outlined in TWDB guidance (Table 5-1), and additional water management strategies identified by Wholesale Water Providers and Water User Groups during interviews conducted by HDR from January to April 2018 to gather feedback on local, on-going studies and future water supply plans. During the May 10th Region N meeting, comments were made to add two water management strategies that were included in previous planning cycles but not recommended in the 2016 Region N Plan. A subcommittee was appointed to review the list of potentially feasible water management strategies and prioritize water management strategies to be included in the TWDB scope of work request for notice to proceed to begin Task 5A- Evaluation of Water Management Strategies. On June 27, 2018, the subcommittee held an open meeting to discuss each potentially feasible water management strategy from the May 10th Region N meeting. The tabular list provided in Table 6-1 represents the subcommittee recommendation which was approved by Region N at the August 9, 2018 meeting for inclusion in the Technical Memorandum. It is important to note that not all strategies listed below will be evaluated and/or recommended in the 2021 Region N Plan due to lack of sponsor, funding constraints, or other factors. This list is strictly a list of potentially feasible water management strategies identified to date for inclusion in the Technical Memorandum in accordance with TWDB guidance.

Table 6-1. Tabular List of Potentially Feasible Water Management Strategies for Consideration in the 2021 Region N Plan

Municipal Water Conservation, including meter replacement
Irrigation Water Conservation
Manufacturing Water Conservation
Mining Water Conservation
Drought Management
Reclaimed Wastewater Supplies and Reuse
Modify Existing Reservoir Operating Policy
Gulf Coast Aquifer Supplies
Brackish Groundwater Desalination
Seawater Desalination
Potential Water System Interconnections
Local Balancing Storage Reservoir to make reliable run-of-the-river rights, affected by drought
Nueces Off-Channel Reservoir Project

Table 6-1. Tabular List of Potentially Feasible Water Management Strategies for Consideration in the 2021 Region N Plan

Lavaca Off-Channel Reservoir Project
Pipeline from Choke Canyon Reservoir to Lake Corpus Christi
GBRA Lower Basin Storage Project
SPMWD Industrial WTP Improvements
ON Stevens WTP Improvements
Alice WTP Improvements
Corpus Christi Aquifer Storage and Recovery
Sediment Removal in Lake Corpus Christi and Choke Canyon Reservoir
Replacement of Alice's Lake Corpus Christi Intake Pump Station

7 Simplified Planning Declaration

A new TWDB provision allows RWPGs to elect to implement simplified planning during planning cycles that do not immediately follow new US Census data releases (e.g. The 2021 Plan cycle would qualify for simplified planning). The basis of this provision is Senate Bill 1511, 85th Legislative Session, which *provided RWPGs the option to implement simplified planning if there are no significant changes to the water availability, water supplies, or water demands in the regional water planning area*. The 31 TAC §357.12 summarizes the simplified planning declaration process, and identifies the Technical Memorandum as the decision point for a regional water planning group to declare its intent whether or not to pursue simplified planning.

Region N does not desire to pursue the simplified planning option provided by the TWDB. Water availability, supplies, and water demands for the 2021 Planning cycle are substantially different as compared to the 2016 Plan.

8 Public Comment

Written comments from the public were accepted for a 14 day period prior to, during, and the 14 day period following the Region N meeting on August 9, 2018 in which this technical memorandum was considered and adopted by the Region N planning group.

No public comments were received.

A

Appendix A

DB22 Reports:

DB 22 Report # 1- WUG Population Projections

DB 22 Report # 2- WUG Water Demand Projections

DB 22 Report # 3- WUG Category Summary

DB 22 Report # 4- Source Water Availability

DB 22 Report # 5- WUG Existing Water Supplies

DB 22 Report # 6- WUG Identified Water Needs/ Surpluses

DB 22 Report # 9- Source Water Balance

DB 22 Report #10a- WUG Data Comparison to 2016 RWP

DB 22 Report #10b- Source Data Comparison to 2016 RWP

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Appendix A: DB 22 Report # 1- WUG Population Projections

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Region N Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
ARANSAS PASS	927	948	946	952	952	952
ROCKPORT	19,120	19,533	19,491	19,620	19,622	19,622
COUNTY-OTHER	4,416	4,510	4,500	4,530	4,529	4,530
SAN ANTONIO-NUECES BASIN TOTAL	**24,463**	**24,991**	**24,937**	**25,102**	**25,103**	**25,104**
ARANSAS COUNTY TOTAL	**24,463**	**24,991**	**24,937**	**25,102**	**25,103**	**25,104**
EL OSO WSC	433	452	459	461	461	461
COUNTY-OTHER	14	15	15	15	15	15
NUECES BASIN TOTAL	**447**	**467**	**474**	**476**	**476**	**476**
BEEVILLE	15,418	16,063	16,343	16,369	16,385	16,391
EL OSO WSC	30	31	32	32	32	32
PETTUS MUD	700	729	742	743	744	744
TDCJ CHASE FIELD	3,425	3,568	3,631	3,637	3,640	3,641
COUNTY-OTHER	13,458	14,021	14,265	14,288	14,302	14,306
SAN ANTONIO-NUECES BASIN TOTAL	**33,031**	**34,412**	**35,013**	**35,069**	**35,103**	**35,114**
BEE COUNTY TOTAL	**33,478**	**34,879**	**35,487**	**35,545**	**35,579**	**35,590**
FALFURRIAS	6,018	6,238	6,452	6,646	6,826	7,064
COUNTY-OTHER	1,765	2,014	2,270	2,535	2,769	2,915
NUECES-RIO GRANDE BASIN TOTAL	**7,783**	**8,252**	**8,722**	**9,181**	**9,595**	**9,979**
BROOKS COUNTY TOTAL	**7,783**	**8,252**	**8,722**	**9,181**	**9,595**	**9,979**
FREER WCID	3,041	3,221	3,370	3,502	3,605	3,691
COUNTY-OTHER	307	324	337	348	356	362
NUECES BASIN TOTAL	**3,348**	**3,545**	**3,707**	**3,850**	**3,961**	**4,053**
DUVAL COUNTY CRD	1,859	1,971	2,062	2,142	2,206	2,258
SAN DIEGO MUD 1	4,044	4,304	4,524	4,725	4,892	5,034
COUNTY-OTHER	3,464	3,650	3,805	3,927	4,021	4,090
NUECES-RIO GRANDE BASIN TOTAL	**9,367**	**9,925**	**10,391**	**10,794**	**11,119**	**11,382**
DUVAL COUNTY TOTAL	**12,715**	**13,470**	**14,098**	**14,644**	**15,080**	**15,435**
COUNTY-OTHER	2,908	3,151	3,372	3,602	3,805	3,991
NUECES BASIN TOTAL	**2,908**	**3,151**	**3,372**	**3,602**	**3,805**	**3,991**
ALICE	22,566	24,424	26,110	27,856	29,395	30,804
JIM WELLS COUNTY FWSD 1	1,943	2,102	2,248	2,398	2,531	2,653
ORANGE GROVE	1,838	1,990	2,127	2,270	2,396	2,510
PREMONT	2,923	3,164	3,382	3,608	3,807	3,990
SAN DIEGO MUD 1	942	1,002	1,054	1,101	1,140	1,173
COUNTY-OTHER	11,867	12,857	13,759	14,698	15,526	16,289
NUECES-RIO GRANDE BASIN TOTAL	**42,079**	**45,539**	**48,680**	**51,931**	**54,795**	**57,419**
JIM WELLS COUNTY TOTAL	**44,987**	**48,690**	**52,052**	**55,533**	**58,600**	**61,410**
COUNTY-OTHER	463	498	504	507	508	508
NUECES-RIO GRANDE BASIN TOTAL	**463**	**498**	**504**	**507**	**508**	**508**
KENEDY COUNTY TOTAL	**463**	**498**	**504**	**507**	**508**	**508**

Region N Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
BAFFIN BAY WSC	1,440	1,579	1,709	1,834	1,953	2,064
KINGSVILLE	28,892	31,651	34,282	36,817	39,194	41,419
NAVAL AIR STATION KINGSVILLE	53	59	63	68	72	76
RICARDO WSC	2,919	3,198	3,464	3,720	3,960	4,185
RIVIERA WATER SYSTEM	736	807	874	938	999	1,056
COUNTY-OTHER	1,527	1,669	1,810	1,947	2,073	2,189
NUECES-RIO GRANDE BASIN TOTAL	**35,567**	**38,963**	**42,202**	**45,324**	**48,251**	**50,989**
KLEBERG COUNTY TOTAL	**35,567**	**38,963**	**42,202**	**45,324**	**48,251**	**50,989**
EL OSO WSC	827	827	827	827	827	827
GEORGE WEST	2,374	2,375	2,375	2,375	2,375	2,375
MCCOY WSC	170	170	170	170	170	170
THREE RIVERS	3,146	3,148	3,148	3,148	3,148	3,148
COUNTY-OTHER	5,166	5,170	5,170	5,170	5,170	5,170
NUECES BASIN TOTAL	**11,683**	**11,690**	**11,690**	**11,690**	**11,690**	**11,690**
LIVE OAK COUNTY TOTAL	**11,683**	**11,690**	**11,690**	**11,690**	**11,690**	**11,690**
COUNTY-OTHER	734	734	734	734	734	734
NUECES BASIN TOTAL	**734**	**734**	**734**	**734**	**734**	**734**
MCMULLEN COUNTY TOTAL	**734**	**734**	**734**	**734**	**734**	**734**
CORPUS CHRISTI	25,232	27,483	28,898	29,726	30,342	30,755
NUECES COUNTY WCID 3	3,277	3,316	3,316	3,316	3,316	3,316
NUECES WSC	72	94	108	124	142	163
RIVER ACRES WSC	2,662	2,899	3,049	3,137	3,201	3,245
COUNTY-OTHER	744	840	907	928	927	905
NUECES BASIN TOTAL	**31,987**	**34,632**	**36,278**	**37,231**	**37,928**	**38,384**
BISHOP	3,446	3,754	3,947	4,060	4,144	4,201
CORPUS CHRISTI	306,770	334,135	351,336	361,408	368,902	373,919
CORPUS CHRISTI NAVAL AIR STATION	707	770	810	833	850	862
DRISCOLL	812	885	930	957	977	990
NUECES COUNTY WCID 3	10,317	10,440	10,440	10,440	10,440	10,440
NUECES COUNTY WCID 4	4,846	5,277	5,549	5,708	5,827	5,905
NUECES WSC	2,641	3,465	3,971	4,552	5,218	5,981
VIOLET WSC	2,142	2,333	2,453	2,523	2,576	2,610
COUNTY-OTHER	10,474	11,827	12,781	13,067	13,056	12,746
NUECES-RIO GRANDE BASIN TOTAL	**342,155**	**372,886**	**392,217**	**403,548**	**411,990**	**417,654**
ARANSAS PASS	11	12	13	13	13	13
COUNTY-OTHER	4	4	5	5	5	5
SAN ANTONIO-NUECES BASIN TOTAL	**15**	**16**	**18**	**18**	**18**	**18**
NUECES COUNTY TOTAL	**374,157**	**407,534**	**428,513**	**440,797**	**449,936**	**456,056**
MATHIS	5,114	5,364	5,507	5,611	5,683	5,730
COUNTY-OTHER	4,004	4,196	4,310	4,395	4,447	4,486

Region N Water User Group (WUG) Population

	WUG POPULATION					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
NUECES BASIN TOTAL	**9,118**	**9,560**	**9,817**	**10,006**	**10,130**	**10,216**
ARANSAS PASS	9,603	10,073	10,342	10,538	10,672	10,761
GREGORY	2,024	2,123	2,179	2,221	2,249	2,268
INGLESIDE	9,610	10,078	10,348	10,545	10,678	10,768
ODEM	2,647	2,777	2,852	2,905	2,942	2,967
PORTLAND	20,646	21,654	22,233	22,655	22,941	23,136
RINCON WSC	3,660	3,839	3,942	4,016	4,068	4,101
SINTON	5,738	6,019	6,179	6,296	6,377	6,430
TAFT	3,768	3,951	4,057	4,133	4,186	4,221
COUNTY-OTHER	1,946	2,040	2,094	2,136	2,162	2,181
SAN ANTONIO-NUECES BASIN TOTAL	**59,642**	**62,554**	**64,226**	**65,445**	**66,275**	**66,833**
SAN PATRICIO COUNTY TOTAL	**68,760**	**72,114**	**74,043**	**75,451**	**76,405**	**77,049**
REGION N TOTAL POPULATION	**614,790**	**661,815**	**692,982**	**714,508**	**731,481**	**744,544**

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Appendix A: DB 22 Report # 2- WUG Water Demand Projections

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Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARANSAS PASS	132	131	127	126	126	126
ROCKPORT	3,462	3,469	3,410	3,404	3,398	3,398
COUNTY-OTHER	491	480	462	457	455	455
MINING	10	7	5	5	5	5
LIVESTOCK	56	56	56	56	56	56
SAN ANTONIO-NUECES BASIN TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
ARANSAS COUNTY TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
EL OSO WSC	94	94	94	94	90	90
COUNTY-OTHER	2	2	2	2	2	2
MINING	57	55	52	45	41	38
LIVESTOCK	80	80	80	80	80	80
IRRIGATION	220	220	220	220	220	220
NUECES BASIN TOTAL	**453**	**451**	**448**	**441**	**433**	**430**
BEEVILLE	3,336	3,397	3,394	3,377	3,375	3,376
EL OSO WSC	6	7	7	7	6	6
PETTUS MUD	104	105	104	103	103	103
TDCJ CHASE FIELD	1,024	1,050	1,055	1,051	1,050	1,050
COUNTY-OTHER	1,873	1,898	1,891	1,872	1,870	1,870
MINING	415	403	376	327	297	280
LIVESTOCK	754	754	754	754	754	754
IRRIGATION	4,205	4,205	4,205	4,205	4,205	4,205
SAN ANTONIO-NUECES BASIN TOTAL	**11,717**	**11,819**	**11,786**	**11,696**	**11,660**	**11,644**
BEE COUNTY TOTAL	**12,170**	**12,270**	**12,234**	**12,137**	**12,093**	**12,074**
FALFURRIAS	1,639	1,668	1,703	1,745	1,790	1,852
COUNTY-OTHER	224	246	269	297	324	341
MANUFACTURING	1	1	1	1	1	1
MINING	357	360	340	324	308	298
LIVESTOCK	463	463	463	463	463	463
IRRIGATION	1,161	1,161	1,161	1,161	1,161	1,161
NUECES-RIO GRANDE BASIN TOTAL	**3,845**	**3,899**	**3,937**	**3,991**	**4,047**	**4,116**
BROOKS COUNTY TOTAL	**3,845**	**3,899**	**3,937**	**3,991**	**4,047**	**4,116**
FREER WCID	687	712	733	755	776	794
COUNTY-OTHER	39	39	40	40	41	42
MINING	125	130	122	112	105	99
LIVESTOCK	94	94	94	94	94	94
IRRIGATION	202	202	202	202	202	202
NUECES BASIN TOTAL	**1,147**	**1,177**	**1,191**	**1,203**	**1,218**	**1,231**
DUVAL COUNTY CRD	260	266	271	277	285	291
SAN DIEGO MUD 1	747	774	797	824	851	876
COUNTY-OTHER	438	445	450	457	467	474
MINING	1,263	1,314	1,230	1,129	1,060	1,005
LIVESTOCK	546	546	546	546	546	546
IRRIGATION	3,840	3,840	3,840	3,840	3,840	3,840
NUECES-RIO GRANDE BASIN TOTAL	**7,094**	**7,185**	**7,134**	**7,073**	**7,049**	**7,032**
DUVAL COUNTY TOTAL	**8,241**	**8,362**	**8,325**	**8,276**	**8,267**	**8,263**
COUNTY-OTHER	412	433	453	479	504	529

Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
MINING	4	4	3	2	1	1
LIVESTOCK	148	148	148	148	148	148
IRRIGATION	354	354	354	354	354	354
NUECES BASIN TOTAL	**918**	**939**	**958**	**983**	**1,007**	**1,032**
ALICE	4,494	4,744	4,978	5,267	5,548	5,812
JIM WELLS COUNTY FWSD 1	131	141	151	161	170	178
ORANGE GROVE	476	506	534	566	596	625
PREMONT	709	752	791	841	886	928
SAN DIEGO MUD 1	174	180	186	192	198	204
COUNTY-OTHER	1,683	1,768	1,850	1,953	2,058	2,158
MANUFACTURING	79	95	95	95	95	95
MINING	67	70	52	38	25	16
LIVESTOCK	754	754	754	754	754	754
IRRIGATION	1,559	1,559	1,559	1,559	1,559	1,559
NUECES-RIO GRANDE BASIN TOTAL	**10,126**	**10,569**	**10,950**	**11,426**	**11,889**	**12,329**
JIM WELLS COUNTY TOTAL	**11,044**	**11,508**	**11,908**	**12,409**	**12,896**	**13,361**
COUNTY-OTHER	244	260	262	263	263	263
MINING	118	123	92	68	43	27
LIVESTOCK	735	735	735	735	735	735
NUECES-RIO GRANDE BASIN TOTAL	**1,097**	**1,118**	**1,089**	**1,066**	**1,041**	**1,025**
KENEDY COUNTY TOTAL	**1,097**	**1,118**	**1,089**	**1,066**	**1,041**	**1,025**
BAFFIN BAY WSC	237	253	268	285	303	320
KINGSVILLE	4,205	4,453	4,706	4,992	5,301	5,599
NAVAL AIR STATION KINGSVILLE	256	284	303	327	347	366
RICARDO WSC	340	361	382	405	430	454
RIVIERA WATER SYSTEM	114	121	129	137	145	153
COUNTY-OTHER	257	272	290	311	331	349
MANUFACTURING	1,809	2,056	2,056	2,056	2,056	2,056
MINING	357	360	340	324	308	298
LIVESTOCK	673	673	673	673	673	673
IRRIGATION	850	850	850	850	850	850
NUECES-RIO GRANDE BASIN TOTAL	**9,098**	**9,683**	**9,997**	**10,360**	**10,744**	**11,118**
KLEBERG COUNTY TOTAL	**9,098**	**9,683**	**9,997**	**10,360**	**10,744**	**11,118**
EL OSO WSC	178	174	171	169	160	160
GEORGE WEST	435	424	414	411	410	410
MCCOY WSC	21	20	20	20	20	20
THREE RIVERS	545	530	518	512	511	511
COUNTY-OTHER	637	622	610	604	602	602
MANUFACTURING	2,274	2,493	2,493	2,493	2,493	2,493
MINING	814	917	907	729	492	332
LIVESTOCK	740	740	740	740	740	740
IRRIGATION	1,630	1,630	1,630	1,630	1,630	1,630
NUECES BASIN TOTAL	**7,274**	**7,550**	**7,503**	**7,308**	**7,058**	**6,898**
LIVE OAK COUNTY TOTAL	**7,274**	**7,550**	**7,503**	**7,308**	**7,058**	**6,898**
COUNTY-OTHER	97	94	91	89	89	89
MANUFACTURING	219	249	249	249	249	249
MINING	4,268	4,804	4,754	2,622	1,850	1,305

Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LIVESTOCK	335	335	335	335	335	335
NUECES BASIN TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
MCMULLEN COUNTY TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
CORPUS CHRISTI	4,872	5,182	5,357	5,463	5,568	5,642
NUECES COUNTY WCID 3	965	962	953	948	947	947
NUECES WSC	12	16	18	20	23	26
RIVER ACRES WSC	426	450	462	470	479	485
COUNTY-OTHER	98	106	112	113	113	110
MANUFACTURING	657	728	728	728	728	728
MINING	644	759	842	908	1,005	1,121
STEAM ELECTRIC POWER	1,670	1,670	1,670	1,670	1,670	1,670
LIVESTOCK	50	50	50	50	50	50
IRRIGATION	51	51	51	51	51	51
NUECES BASIN TOTAL	**9,445**	**9,974**	**10,243**	**10,421**	**10,634**	**10,830**
BISHOP	593	627	645	660	672	681
CORPUS CHRISTI	59,238	62,998	65,136	66,425	67,690	68,598
CORPUS CHRISTI NAVAL AIR STATION	1,085	1,178	1,237	1,271	1,296	1,315
DRISCOLL	105	110	112	114	116	117
NUECES COUNTY WCID 3	3,039	3,030	2,999	2,985	2,982	2,981
NUECES COUNTY WCID 4	2,465	2,661	2,782	2,854	2,912	2,951
NUECES WSC	445	573	650	742	848	973
VIOLET WSC	186	193	196	198	201	204
COUNTY-OTHER	1,376	1,497	1,582	1,599	1,594	1,556
MANUFACTURING	44,754	49,635	49,635	49,635	49,635	49,635
MINING	51	60	67	72	80	89
STEAM ELECTRIC POWER	407	407	407	407	407	407
LIVESTOCK	241	241	241	241	241	241
IRRIGATION	1,489	1,489	1,489	1,489	1,489	1,489
NUECES-RIO GRANDE BASIN TOTAL	**115,474**	**124,699**	**127,178**	**128,692**	**130,163**	**131,237**
ARANSAS PASS	2	2	2	2	2	2
COUNTY-OTHER	1	1	1	1	1	1
MINING	29	34	38	41	45	50
SAN ANTONIO-NUECES BASIN TOTAL	**32**	**37**	**41**	**44**	**48**	**53**
NUECES COUNTY TOTAL	**124,951**	**134,710**	**137,462**	**139,157**	**140,845**	**142,120**
MATHIS	653	658	655	661	668	673
COUNTY-OTHER	567	576	590	600	606	611
MANUFACTURING	24,323	27,067	27,067	27,067	27,067	27,067
MINING	78	88	92	96	103	112
LIVESTOCK	200	200	200	200	200	200
IRRIGATION	1,464	1,464	1,464	1,464	1,464	1,464
NUECES BASIN TOTAL	**27,285**	**30,053**	**30,068**	**30,088**	**30,108**	**30,127**
ARANSAS PASS	1,370	1,391	1,392	1,399	1,414	1,425
GREGORY	339	344	348	354	357	360
INGLESIDE	1,013	1,024	1,023	1,026	1,036	1,044
ODEM	395	401	401	404	408	411
PORTLAND	3,389	3,458	3,477	3,503	3,539	3,569

Region N Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
RINCON WSC	368	377	381	385	389	392
SINTON	1,345	1,382	1,396	1,411	1,427	1,438
TAFT	540	546	545	552	558	563
COUNTY-OTHER	276	280	287	292	294	297
MANUFACTURING	14,518	16,156	16,156	16,156	16,156	16,156
MINING	294	333	348	364	389	421
STEAM ELECTRIC POWER	1,919	1,919	1,919	1,919	1,919	1,919
LIVESTOCK	196	196	196	196	196	196
IRRIGATION	13,181	13,181	13,181	13,181	13,181	13,181
SAN ANTONIO-NUECES BASIN TOTAL	**39,143**	**40,988**	**41,050**	**41,142**	**41,263**	**41,372**
SAN PATRICIO COUNTY TOTAL	**66,428**	**71,041**	**71,118**	**71,230**	**71,371**	**71,499**
REGION N TOTAL DEMAND	**253,218**	**269,766**	**273,062**	**273,277**	**274,925**	**276,492**

Appendix A: DB 22 Report # 3- WUG Category Summary

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Region N Water User Group (WUG) Category Summary*

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	551,529	594,295	622,344	641,676	657,076	669,122
DEMAND (acre-feet per year)	106,651	112,179	115,413	117,895	120,407	122,499
EXISTING SUPPLIES (acre-feet per year)	101,974	107,427	110,666	113,143	115,637	117,706
NEEDS (acre-feet per year)	4,686	4,762	4,757	4,762	4,780	4,803

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	63,261	67,520	70,638	72,832	74,405	75,422
DEMAND (acre-feet per year)	8,715	9,019	9,242	9,429	9,614	9,749
EXISTING SUPPLIES (acre-feet per year)	3,086	3,119	3,145	3,181	3,218	3,256
NEEDS (acre-feet per year)	5,629	5,900	6,098	6,248	6,396	6,493

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	88,634	98,480	98,480	98,480	98,480	98,480
EXISTING SUPPLIES (acre-feet per year)	87,759	81,738	76,658	72,420	67,828	63,904
NEEDS (acre-feet per year)	2,286	16,742	21,822	26,060	30,652	34,576

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	8,951	9,821	9,660	7,206	6,157	5,497
EXISTING SUPPLIES (acre-feet per year)	6,748	7,391	7,333	5,021	3,999	3,281
NEEDS (acre-feet per year)	2,203	2,430	2,327	2,185	2,158	2,216

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	3,996	3,996	3,996	3,996	3,996	3,996
EXISTING SUPPLIES (acre-feet per year)	3,996	3,996	3,996	3,996	3,996	3,996
NEEDS (acre-feet per year)	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	6,065	6,065	6,065	6,065	6,065	6,065
EXISTING SUPPLIES (acre-feet per year)	6,065	6,065	6,065	6,065	6,065	6,065
NEEDS (acre-feet per year)	0	0	0	0	0	0

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	30,206	30,206	30,206	30,206	30,206	30,206
EXISTING SUPPLIES (acre-feet per year)	28,923	28,732	28,732	28,732	28,732	28,732
NEEDS (acre-feet per year)	1,283	1,474	1,474	1,474	1,474	1,474

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

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Appendix A: DB 22 Report # 4- Source Water Availability

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Region N Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CARRIZO-WILCOX AQUIFER	BEE	NUECES	FRESH	0	0	0	0	0	0
CARRIZO-WILCOX AQUIFER	LIVE OAK	NUECES	FRESH	0	0	0	0	0	0
CARRIZO-WILCOX AQUIFER	MCMULLEN	NUECES	FRESH	7,056	7,056	4,405	4,405	4,405	4,405
GULF COAST AQUIFER SYSTEM	ARANSAS	SAN ANTONIO-NUECES	FRESH	1,542	1,542	1,542	1,542	1,542	1,542
GULF COAST AQUIFER SYSTEM	BEE	NUECES	FRESH	797	920	976	1,005	1,022	1,022
GULF COAST AQUIFER SYSTEM	BEE	SAN ANTONIO-NUECES	FRESH/BRACKISH	17,640	18,917	19,526	19,776	19,951	19,951
GULF COAST AQUIFER SYSTEM	BROOKS	NUECES-RIO GRANDE	FRESH	5,582	6,352	7,122	7,892	7,892	7,892
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES	FRESH	326	351	376	401	428	428
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES-RIO GRANDE	FRESH	20,245	21,818	23,388	24,962	26,535	26,535
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES	FRESH	593	593	593	593	593	593
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES-RIO GRANDE	FRESH/BRACKISH	8,551	9,090	9,593	10,132	10,424	10,424
GULF COAST AQUIFER SYSTEM	KENEDY	NUECES-RIO GRANDE	FRESH	13,301	18,621	23,941	29,261	29,261	29,261
GULF COAST AQUIFER SYSTEM	KLEBERG	NUECES-RIO GRANDE	FRESH	10,365	13,082	15,800	18,518	18,711	18,711
GULF COAST AQUIFER SYSTEM	LIVE OAK	NUECES	FRESH	8,297	9,297	8,522	8,400	8,400	8,400
GULF COAST AQUIFER SYSTEM	LIVE OAK	SAN ANTONIO-NUECES	FRESH	41	46	42	41	41	41
GULF COAST AQUIFER SYSTEM	MCMULLEN	NUECES	FRESH	510	510	510	510	510	510
GULF COAST AQUIFER SYSTEM	NUECES	NUECES	FRESH	727	756	787	816	845	845
GULF COAST AQUIFER SYSTEM	NUECES	NUECES-RIO GRANDE	FRESH	5,862	6,191	6,522	6,851	7,079	7,079
GULF COAST AQUIFER SYSTEM	NUECES	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	NUECES	FRESH	4,130	4,502	4,874	5,247	5,619	5,619
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH/BRACKISH	39,481	40,514	41,548	42,581	43,615	43,615
QUEEN CITY AQUIFER	MCMULLEN	NUECES	FRESH	134	134	134	134	134	134
SPARTA AQUIFER	MCMULLEN	NUECES	FRESH	89	89	89	89	89	89
YEGUA-JACKSON AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
			GROUNDWATER TOTAL SOURCE AVAILABILITY	**145,269**	**160,381**	**170,290**	**183,156**	**187,096**	**187,096**

REUSE SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DIRECT REUSE	NUECES	NUECES-RIO GRANDE	FRESH	1,213	1,213	1,213	1,213	1,213	1,213
DIRECT REUSE	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	2,688	2,688	2,688	2,688	2,688	2,688
			REUSE TOTAL SOURCE AVAILABILITY	**3,901**	**3,901**	**3,901**	**3,901**	**3,901**	**3,901**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	RESERVOIR	NUECES	FRESH	106,560	104,260	102,060	99,860	97,560	95,360

*Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

Region N Source Availability

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NUECES LIVESTOCK LOCAL SUPPLY	BEE	NUECES	FRESH	44	44	44	44	44	44
NUECES LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES	FRESH	28	28	28	28	28	28
NUECES LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES	FRESH	33	33	33	33	33	33
NUECES LIVESTOCK LOCAL SUPPLY	LIVE OAK	NUECES	FRESH	211	211	211	211	211	211
NUECES LIVESTOCK LOCAL SUPPLY	MCMULLEN	NUECES	FRESH	279	279	295	295	295	295
NUECES LIVESTOCK LOCAL SUPPLY	NUECES	NUECES	FRESH	50	50	50	50	50	50
NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	NUECES	FRESH	83	83	83	83	83	83
NUECES RUN-OF-RIVER	LIVE OAK	NUECES	FRESH	1,500	1,500	1,500	1,500	1,500	1,500
NUECES RUN-OF-RIVER	NUECES	NUECES	FRESH	384	384	384	384	384	384
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	BROOKS	NUECES-RIO GRANDE	FRESH	125	125	125	125	125	125
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES-RIO GRANDE	FRESH	179	179	179	179	179	179
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	NUECES	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE RUN-OF-RIVER	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	ARANSAS	SAN ANTONIO-NUECES	FRESH	33	33	33	33	33	33
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	BEE	SAN ANTONIO-NUECES	FRESH	420	420	420	420	420	420
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	80	80	80	80	80	80
SAN ANTONIO-NUECES RUN-OF-RIVER	BEE	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
			SURFACE WATER TOTAL SOURCE AVAILABILITY	**110,013**	**107,713**	**105,529**	**103,329**	**101,029**	**98,829**

REGION N TOTAL SOURCE AVAILABILITY	**259,183**	**271,995**	**279,720**	**290,386**	**292,026**	**289,826**

*Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

Appendix A: DB 22 Report # 5- WUG Existing Water Supplies

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Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	66	65	64	63	63	63
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	66	66	63	63	63	63
ROCKPORT	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,731	1,735	1,705	1,702	1,699	1,699
ROCKPORT	P	TEXANA LAKE/RESERVOIR	1,731	1,734	1,705	1,702	1,699	1,699
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	60	59	57	56	56	56
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	371	362	349	345	343	343
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	60	59	56	56	56	56
MINING	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	10	7	5	5	5	5
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | ARANSAS COUNTY	23	23	23	23	23	23
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	33	33	33	33	33	33
		SAN ANTONIO-NUECES BASIN TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
		ARANSAS COUNTY TOTAL	**4,151**	**4,143**	**4,060**	**4,048**	**4,040**	**4,040**
EL OSO WSC	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	0	0	0	0	0	0
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	2	2	2	2	2	2
MINING	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	57	55	52	45	41	38
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	80	80	80	80	80	80
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	220	220	220	220	220	220
		NUECES BASIN TOTAL	**359**	**357**	**354**	**347**	**343**	**340**
BEEVILLE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,925	1,986	1,983	1,966	1,964	1,965
BEEVILLE	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	1,411	1,411	1,411	1,411	1,411	1,411
EL OSO WSC	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	6	7	7	7	6	6
PETTUS MUD	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	104	105	104	103	103	103
TDCJ CHASE FIELD	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	847	847	847	847	847	847
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	216	216	216	216	216	216
MINING	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	218	218	218	218	218	218
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	754	754	754	754	754	754
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BEE COUNTY	3,853	3,853	3,853	3,853	3,853	3,853
IRRIGATION	N	SAN ANTONIO-NUECES RUN-OF-RIVER	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**9,334**	**9,397**	**9,393**	**9,375**	**9,372**	**9,373**
		BEE COUNTY TOTAL	**9,693**	**9,754**	**9,747**	**9,722**	**9,715**	**9,713**
FALFURRIAS	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1,639	1,668	1,703	1,745	1,790	1,852
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	32	32	32	32	32	32
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1	1	1	1	1	1
MINING	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	178	178	178	178	178	178
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	338	338	338	338	338	338
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	125	125	125	125	125	125
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | BROOKS COUNTY	1,161	1,161	1,161	1,161	1,161	1,161
		NUECES-RIO GRANDE BASIN TOTAL	**3,474**	**3,503**	**3,538**	**3,580**	**3,625**	**3,687**
		BROOKS COUNTY TOTAL	**3,474**	**3,503**	**3,538**	**3,580**	**3,625**	**3,687**
FREER WCID	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	687	712	733	755	776	794
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	28	28	28	28	28	28
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	94	94	94	94	94	94
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	202	202	202	202	202	202

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		NUECES BASIN TOTAL	**1,011**	**1,036**	**1,057**	**1,079**	**1,100**	**1,118**
DUVAL COUNTY CRD	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	260	266	271	277	285	291
SAN DIEGO MUD 1	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	459	459	459	459	459	459
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	648	648	648	648	648	648
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	544	544	544	544	544	544
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	2	2	2	2	2	2
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	3,840	3,840	3,840	3,840	3,840	3,840
		NUECES-RIO GRANDE BASIN TOTAL	**5,753**	**5,759**	**5,764**	**5,770**	**5,778**	**5,784**
		DUVAL COUNTY TOTAL	**6,764**	**6,795**	**6,821**	**6,849**	**6,878**	**6,902**
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	0	0	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	0	0	0	0	0	0
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	115	115	115	115	115	115
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	33	33	33	33	33	33
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	315	315	315	315	315	315
		NUECES BASIN TOTAL	**463**	**463**	**463**	**463**	**463**	**463**
ALICE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	2,247	2,372	2,489	2,634	2,774	2,906
ALICE	P	TEXANA LAKE/RESERVOIR	2,247	2,372	2,489	2,633	2,774	2,906
JIM WELLS COUNTY FWSD 1	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	131	141	151	161	170	178
ORANGE GROVE	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	476	506	534	566	596	625
PREMONT	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	709	752	791	841	886	928
SAN DIEGO MUD 1	N	GULF COAST AQUIFER SYSTEM | DUVAL COUNTY	174	180	186	192	198	204
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	37	37	37	37	37	37
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	79	79	79	79	79	79
MINING	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	19	19	19	19	19	16
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	575	575	575	575	575	575
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	179	179	179	179	179	179
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | JIM WELLS COUNTY	1,265	1,265	1,265	1,265	1,265	1,265
		NUECES-RIO GRANDE BASIN TOTAL	**8,138**	**8,477**	**8,794**	**9,181**	**9,552**	**9,898**
		JIM WELLS COUNTY TOTAL	**8,601**	**8,940**	**9,257**	**9,644**	**10,015**	**10,361**
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	244	260	262	263	263	263
MINING	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	60	60	60	60	43	27
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | KENEDY COUNTY	735	735	735	735	735	735
		NUECES-RIO GRANDE BASIN TOTAL	**1,039**	**1,055**	**1,057**	**1,058**	**1,041**	**1,025**
		KENEDY COUNTY TOTAL	**1,039**	**1,055**	**1,057**	**1,058**	**1,041**	**1,025**
BAFFIN BAY WSC	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	237	253	268	285	303	320
KINGSVILLE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	211	252	268	289	438	518
KINGSVILLE	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	3,781	3,946	4,168	4,415	4,424	4,561
KINGSVILLE	P	TEXANA LAKE/RESERVOIR	213	255	270	288	439	520
NAVAL AIR STATION KINGSVILLE	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	256	284	303	327	347	366
RICARDO WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	170	180	191	202	215	227
RICARDO WSC	P	TEXANA LAKE/RESERVOIR	170	181	191	203	215	227
RIVIERA WATER SYSTEM	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	114	121	129	137	145	153
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	20	21	22	24	25	26

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	218	231	247	264	281	297
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	19	20	22	23	25	26
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	1,809	1,809	1,809	1,809	1,809	1,809
MINING	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	218	218	218	218	218	218
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	673	673	673	673	673	673
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | KLEBERG COUNTY	850	850	850	850	850	850
		NUECES-RIO GRANDE BASIN TOTAL	**8,959**	**9,294**	**9,629**	**10,007**	**10,407**	**10,791**
		KLEBERG COUNTY TOTAL	**8,959**	**9,294**	**9,629**	**10,007**	**10,407**	**10,791**
EL OSO WSC	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	178	174	171	169	160	160
GEORGE WEST	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	435	424	414	411	410	410
MCCOY WSC	N	CARRIZO-WILCOX AQUIFER | LIVE OAK COUNTY	30	30	30	30	30	30
THREE RIVERS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	545	530	518	512	511	511
THREE RIVERS	N	NUECES RUN-OF-RIVER	0	0	0	0	0	0
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	637	622	610	604	602	602
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	965	965	965	965	965	965
MANUFACTURING	N	NUECES RUN-OF-RIVER	1,309	1,500	1,500	1,500	1,500	1,500
MINING	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	814	917	907	729	492	332
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	529	529	529	529	529	529
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	211	211	211	211	211	211
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | LIVE OAK COUNTY	1,096	1,096	1,096	1,096	1,096	1,096
IRRIGATION	N	NUECES RUN-OF-RIVER	191	0	0	0	0	0
		NUECES BASIN TOTAL	**6,940**	**6,998**	**6,951**	**6,756**	**6,506**	**6,346**
		LIVE OAK COUNTY TOTAL	**6,940**	**6,998**	**6,951**	**6,756**	**6,506**	**6,346**
COUNTY-OTHER	N	CARRIZO-WILCOX AQUIFER | MCMULLEN COUNTY	97	94	91	89	89	89
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	219	249	249	249	249	249
MINING	N	CARRIZO-WILCOX AQUIFER | MCMULLEN COUNTY	3,810	4,376	4,310	2,178	1,406	861
MINING	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	235	205	221	221	221	221
MINING	N	QUEEN CITY AQUIFER | MCMULLEN COUNTY	134	134	134	134	134	134
MINING	N	SPARTA AQUIFER | MCMULLEN COUNTY	89	89	89	89	89	89
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | MCMULLEN COUNTY	56	56	40	40	40	40
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	279	279	295	295	295	295
		NUECES BASIN TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
		MCMULLEN COUNTY TOTAL	**4,919**	**5,482**	**5,429**	**3,295**	**2,523**	**1,978**
CORPUS CHRISTI	K	COLORADO RUN-OF-RIVER	328	426	517	608	802	1,094
CORPUS CHRISTI	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	3,431	3,312	3,286	3,322	3,264	3,071
CORPUS CHRISTI	P	TEXANA LAKE/RESERVOIR	1,113	1,444	1,554	1,533	1,502	1,477
NUECES COUNTY WCID 3		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
NUECES WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	6	8	9	10	11	13
NUECES WSC	P	TEXANA LAKE/RESERVOIR	6	8	9	10	12	13
RIVER ACRES WSC	N	NUECES RUN-OF-RIVER	192	192	192	192	192	192
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	49	53	56	57	57	55
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	49	53	56	56	56	55
MANUFACTURING	K	COLORADO RUN-OF-RIVER	0	0	0	0	45	45
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	0	45	45	45	0	0

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	657	683	683	683	683	683
MINING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	44	44	44	44	44	44
STEAM ELECTRIC POWER	K	COLORADO RUN-OF-RIVER	557	557	557	557	557	557
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	556	556	556	556	556	556
STEAM ELECTRIC POWER	P	TEXANA LAKE/RESERVOIR	557	557	557	557	557	557
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	50	50	50	50	50	50
IRRIGATION		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		NUECES BASIN TOTAL	**7,595**	**7,988**	**8,171**	**8,280**	**8,388**	**8,462**
BISHOP	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	115	127	138	149	160	168
BISHOP	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	282	282	282	282	282	282
BISHOP	P	TEXANA LAKE/RESERVOIR	115	126	138	149	159	167
CORPUS CHRISTI	K	COLORADO RUN-OF-RIVER	3,980	5,182	6,291	7,400	9,754	13,298
CORPUS CHRISTI	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	41,719	40,259	39,953	40,391	39,680	37,345
CORPUS CHRISTI	P	TEXANA LAKE/RESERVOIR	13,539	17,557	18,892	18,634	18,256	17,955
CORPUS CHRISTI NAVAL AIR STATION	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	543	589	619	636	648	658
CORPUS CHRISTI NAVAL AIR STATION	P	TEXANA LAKE/RESERVOIR	542	589	618	635	648	657
DRISCOLL	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	52	55	56	57	58	59
DRISCOLL	P	TEXANA LAKE/RESERVOIR	53	55	56	57	58	58
NUECES COUNTY WCID 3	N	NUECES RUN-OF-RIVER	192	192	192	192	192	192
NUECES COUNTY WCID 4	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,233	1,331	1,391	1,427	1,456	1,475
NUECES COUNTY WCID 4	P	TEXANA LAKE/RESERVOIR	1,232	1,330	1,391	1,427	1,456	1,476
NUECES WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	223	287	325	371	424	486
NUECES WSC	P	TEXANA LAKE/RESERVOIR	222	286	325	371	424	487
VIOLET WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	93	96	98	99	100	102
VIOLET WSC	P	TEXANA LAKE/RESERVOIR	93	97	98	99	101	102
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	51	56	61	66	73	81
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	31	31	31	31	31	31
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	49	54	60	67	73	80
MANUFACTURING	K	COLORADO RUN-OF-RIVER	30,000	28,700	27,500	26,300	23,707	19,871
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	8,411	8,366	6,240	3,302	1,411	1,411
MANUFACTURING	N	DIRECT REUSE	1,213	1,213	1,213	1,213	1,213	1,213
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	119	119	119	119	119	119
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	6,422	1,708	0	0	0	0
MINING	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	51	60	67	72	80	89
STEAM ELECTRIC POWER	K	COLORADO RUN-OF-RIVER	135	135	135	135	135	135
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	136	136	136	136	136	136
STEAM ELECTRIC POWER	P	TEXANA LAKE/RESERVOIR	136	136	136	136	136	136
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	241	241	241	241	241	241
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | NUECES COUNTY	1,489	1,489	1,489	1,489	1,489	1,489
IRRIGATION	N	NUECES-RIO GRANDE RUN-OF-RIVER	0	0	0	0	0	0

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		NUECES-RIO GRANDE BASIN TOTAL	**112,712**	**110,884**	**108,291**	**105,683**	**102,700**	**99,999**
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1	1	1	1	1	1
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	1	1	1	1	1	1
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	1	1	1	1	1	1
MINING		NO WATER SUPPLY ASSOCIATED WITH WUG	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**3**	**3**	**3**	**3**	**3**	**3**
		NUECES COUNTY TOTAL	**120,310**	**118,875**	**116,465**	**113,966**	**111,091**	**108,464**
MATHIS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	326	329	327	330	334	336
MATHIS	P	TEXANA LAKE/RESERVOIR	327	329	328	331	334	337
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	330	324	315	307	303	300
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	186	189	193	197	199	200
COUNTY-OTHER	P	TEXANA LAKE/RESERVOIR	51	63	82	96	104	111
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	22,037	20,145	20,099	19,999	19,891	19,803
MINING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	28	28	28	28	28	28
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	117	117	117	117	117	117
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	83	83	83	83	83	83
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	1,444	1,444	1,444	1,444	1,444	1,444
		NUECES BASIN TOTAL	**24,929**	**23,051**	**23,016**	**22,932**	**22,837**	**22,759**
ARANSAS PASS	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	685	696	696	700	707	713
ARANSAS PASS	P	TEXANA LAKE/RESERVOIR	685	695	696	699	707	712
GREGORY	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	169	172	174	177	179	180
GREGORY	P	TEXANA LAKE/RESERVOIR	170	172	174	177	178	180
INGLESIDE	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	507	512	512	513	518	522
INGLESIDE	P	TEXANA LAKE/RESERVOIR	506	512	511	513	518	522
ODEM	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	205	209	209	210	212	215
ODEM	P	TEXANA LAKE/RESERVOIR	190	192	192	194	196	196
PORTLAND	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	2,073	2,116	2,128	2,144	2,165	2,184
PORTLAND	P	TEXANA LAKE/RESERVOIR	1,316	1,342	1,349	1,359	1,374	1,385
RINCON WSC	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	184	188	190	192	194	196
RINCON WSC	P	TEXANA LAKE/RESERVOIR	184	189	191	193	195	196
SINTON	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	1,345	1,382	1,396	1,411	1,427	1,438
TAFT	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	319	322	322	326	330	332
TAFT	P	TEXANA LAKE/RESERVOIR	221	224	223	226	228	231
COUNTY-OTHER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	258	262	269	274	276	279
COUNTY-OTHER	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	18	18	18	18	18	18
MANUFACTURING	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	9,891	11,650	11,677	11,732	11,788	11,832
MANUFACTURING	N	DIRECT REUSE	448	448	448	448	448	448
MANUFACTURING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	25	25	25	25	25	25

Region N Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	4,154	4,033	4,006	3,951	3,895	3,851
MINING	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	107	107	107	107	107	107
STEAM ELECTRIC POWER	N	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	1,919	1,919	1,919	1,919	1,919	1,919
LIVESTOCK	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	116	116	116	116	116	116
LIVESTOCK	N	LOCAL SURFACE WATER SUPPLY	80	80	80	80	80	80
IRRIGATION	N	GULF COAST AQUIFER SYSTEM | SAN PATRICIO COUNTY	12,997	12,997	12,997	12,997	12,997	12,997
IRRIGATION	N	SAN ANTONIO-NUECES RUN-OF-RIVER	0	0	0	0	0	0
		SAN ANTONIO-NUECES BASIN TOTAL	**38,772**	**40,578**	**40,625**	**40,701**	**40,797**	**40,874**
		SAN PATRICIO COUNTY TOTAL	**63,701**	**63,629**	**63,641**	**63,633**	**63,634**	**63,633**
		REGION N TOTAL EXISTING WATER SUPPLY	**238,551**	**238,468**	**236,595**	**232,558**	**229,475**	**226,940**

Appendix A: DB 22 Report # 6- WUG Identified Water Needs/ Surpluses

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Region N Water User Group (WUG) Needs/Surplus*

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARANSAS COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
ROCKPORT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
BEE COUNTY - NUECES BASIN						
EL OSO WSC	(94)	(94)	(94)	(94)	(90)	(90)
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
BEE COUNTY - SAN ANTONIO-NUECES BASIN						
BEEVILLE	0	0	0	0	0	0
EL OSO WSC	0	0	0	0	0	0
PETTUS MUD	0	0	0	0	0	0
TDCJ CHASE FIELD	(177)	(203)	(208)	(204)	(203)	(203)
COUNTY-OTHER	(1,657)	(1,682)	(1,675)	(1,656)	(1,654)	(1,654)
MINING	(197)	(185)	(158)	(109)	(79)	(62)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(352)	(352)	(352)	(352)	(352)	(352)
BROOKS COUNTY - NUECES-RIO GRANDE BASIN						
FALFURRIAS	0	0	0	0	0	0
COUNTY-OTHER	(192)	(214)	(237)	(265)	(292)	(309)
MANUFACTURING	0	0	0	0	0	0
MINING	(179)	(182)	(162)	(146)	(130)	(120)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES BASIN						
FREER WCID	0	0	0	0	0	0
COUNTY-OTHER	(39)	(39)	(40)	(40)	(41)	(42)
MINING	(97)	(102)	(94)	(84)	(77)	(71)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DUVAL COUNTY - NUECES-RIO GRANDE BASIN						
DUVAL COUNTY CRD	0	0	0	0	0	0
SAN DIEGO MUD 1	(288)	(315)	(338)	(365)	(392)	(417)
COUNTY-OTHER	(438)	(445)	(450)	(457)	(467)	(474)
MINING	(615)	(666)	(582)	(481)	(412)	(357)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JIM WELLS COUNTY - NUECES BASIN						
COUNTY-OTHER	(412)	(433)	(453)	(479)	(504)	(529)
MINING	(4)	(4)	(3)	(2)	(1)	(1)
LIVESTOCK	0	0	0	0	0	0

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

Region N Water User Group (WUG) Needs/Surplus*

IRRIGATION	(39)	(39)	(39)	(39)	(39)	(39)
JIM WELLS COUNTY - NUECES-RIO GRANDE BASIN						
ALICE	0	0	0	0	0	0
JIM WELLS COUNTY FWSD 1	0	0	0	0	0	0
ORANGE GROVE	0	0	0	0	0	0
PREMONT	0	0	0	0	0	0
SAN DIEGO MUD 1	0	0	0	0	0	0
COUNTY-OTHER	(1,646)	(1,731)	(1,813)	(1,916)	(2,021)	(2,121)
MANUFACTURING	0	(16)	(16)	(16)	(16)	(16)
MINING	(48)	(51)	(33)	(19)	(6)	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(294)	(294)	(294)	(294)	(294)	(294)
KENEDY COUNTY - NUECES-RIO GRANDE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	(58)	(63)	(32)	(8)	0	0
LIVESTOCK	0	0	0	0	0	0
KLEBERG COUNTY - NUECES-RIO GRANDE BASIN						
BAFFIN BAY WSC	0	0	0	0	0	0
KINGSVILLE	0	0	0	0	0	0
NAVAL AIR STATION KINGSVILLE	0	0	0	0	0	0
RICARDO WSC	0	0	0	0	0	0
RIVIERA WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	1	0	0	0
MANUFACTURING	0	(247)	(247)	(247)	(247)	(247)
MINING	(139)	(142)	(122)	(106)	(90)	(80)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LIVE OAK COUNTY - NUECES BASIN						
EL OSO WSC	0	0	0	0	0	0
GEORGE WEST	0	0	0	0	0	0
MCCOY WSC	9	10	10	10	10	10
THREE RIVERS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	(28)	(28)	(28)	(28)	(28)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(343)	(534)	(534)	(534)	(534)	(534)
MCMULLEN COUNTY - NUECES BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
NUECES COUNTY - NUECES BASIN						
CORPUS CHRISTI	0	0	0	0	0	0
NUECES COUNTY WCID 3	(965)	(962)	(953)	(948)	(947)	(947)
NUECES WSC	0	0	0	0	0	0
RIVER ACRES WSC	(234)	(258)	(270)	(278)	(287)	(293)

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

Region N Water User Group (WUG) Needs/Surplus*

COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	(600)	(715)	(798)	(864)	(961)	(1,077)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(51)	(51)	(51)	(51)	(51)	(51)
NUECES COUNTY - NUECES-RIO GRANDE BASIN						
BISHOP	(81)	(92)	(87)	(80)	(71)	(64)
CORPUS CHRISTI	0	0	0	0	0	0
CORPUS CHRISTI NAVAL AIR STATION	0	0	0	0	0	0
DRISCOLL	0	0	0	0	0	0
NUECES COUNTY WCID 3	(2,847)	(2,838)	(2,807)	(2,793)	(2,790)	(2,789)
NUECES COUNTY WCID 4	0	0	0	0	0	0
NUECES WSC	0	0	0	0	0	0
VIOLET WSC	0	0	0	0	0	0
COUNTY-OTHER	(1,245)	(1,356)	(1,430)	(1,435)	(1,417)	(1,364)
MANUFACTURING	1,411	(9,529)	(14,563)	(18,701)	(23,185)	(27,021)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
NUECES COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	(29)	(34)	(38)	(41)	(45)	(50)
SAN PATRICIO COUNTY - NUECES BASIN						
MATHIS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	(2,286)	(6,922)	(6,968)	(7,068)	(7,176)	(7,264)
MINING	(50)	(60)	(64)	(68)	(75)	(84)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(20)	(20)	(20)	(20)	(20)	(20)
SAN PATRICIO COUNTY - SAN ANTONIO-NUECES BASIN						
ARANSAS PASS	0	0	0	0	0	0
GREGORY	0	0	0	0	0	0
INGLESIDE	0	0	0	0	0	0
ODEM	0	0	0	0	0	0
PORTLAND	0	0	0	0	0	0
RINCON WSC	0	0	0	0	0	0
SINTON	0	0	0	0	0	0
TAFT	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	(187)	(226)	(241)	(257)	(282)	(314)
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(184)	(184)	(184)	(184)	(184)	(184)

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

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Appendix A: DB 22 Report # 9- Source Water Balance

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Region N Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CARRIZO-WILCOX AQUIFER	BEE	NUECES	FRESH	0	0	0	0	0	0
CARRIZO-WILCOX AQUIFER	LIVE OAK	NUECES	FRESH	(30)	(30)	(30)	(30)	(30)	(30)
CARRIZO-WILCOX AQUIFER	MCMULLEN	NUECES	FRESH	3,149	2,586	4	2,138	2,910	3,455
GULF COAST AQUIFER SYSTEM	ARANSAS	SAN ANTONIO-NUECES	FRESH	1,138	1,150	1,165	1,169	1,171	1,171
GULF COAST AQUIFER SYSTEM	BEE	NUECES	FRESH	438	563	622	658	679	682
GULF COAST AQUIFER SYSTEM	BEE	SAN ANTONIO-NUECES	FRESH/BRACKISH	10,231	11,506	12,116	12,367	12,543	12,543
GULF COAST AQUIFER SYSTEM	BROOKS	NUECES-RIO GRANDE	FRESH	2,233	2,974	3,709	4,437	4,392	4,330
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES	FRESH	2	27	52	77	104	104
GULF COAST AQUIFER SYSTEM	DUVAL	NUECES-RIO GRANDE	FRESH	13,633	15,169	16,707	18,247	19,785	19,755
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES	FRESH	163	163	163	163	163	163
GULF COAST AQUIFER SYSTEM	JIM WELLS	NUECES-RIO GRANDE	FRESH/BRACKISH	5,260	5,716	6,142	6,589	6,797	6,721
GULF COAST AQUIFER SYSTEM	KENEDY	NUECES-RIO GRANDE	FRESH	12,262	17,566	22,884	28,203	28,220	28,236
GULF COAST AQUIFER SYSTEM	KLEBERG	NUECES-RIO GRANDE	FRESH	2,209	4,697	7,135	9,540	9,661	9,464
GULF COAST AQUIFER SYSTEM	LIVE OAK	NUECES	FRESH	3,643	4,570	3,830	3,897	4,146	4,306
GULF COAST AQUIFER SYSTEM	LIVE OAK	SAN ANTONIO-NUECES	FRESH	41	46	42	41	41	41
GULF COAST AQUIFER SYSTEM	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	NUECES	NUECES	FRESH	26	29	60	89	118	118
GULF COAST AQUIFER SYSTEM	NUECES	NUECES-RIO GRANDE	FRESH	3,649	3,969	4,293	4,617	4,837	4,828
GULF COAST AQUIFER SYSTEM	NUECES	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	NUECES	FRESH	2,355	2,724	3,092	3,461	3,831	3,830
GULF COAST AQUIFER SYSTEM	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH/BRACKISH	24,873	25,869	26,889	27,907	28,925	28,914
QUEEN CITY AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
SPARTA AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
YEGUA-JACKSON AQUIFER	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
GROUNDWATER TOTAL SOURCE WATER BALANCE				**85,275**	**99,294**	**108,875**	**123,570**	**128,293**	**128,631**

REUSE SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DIRECT REUSE	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
DIRECT REUSE	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	2,240	2,240	2,240	2,240	2,240	2,240
REUSE TOTAL SOURCE WATER BALANCE				**2,240**	**2,240**	**2,240**	**2,240**	**2,240**	**2,240**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM	RESERVOIR	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	BEE	NUECES	FRESH	44	44	44	44	44	44

*Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

Region N Source Water Balance (Availability - WUG Supply)

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NUECES LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES	FRESH	28	28	28	28	28	28
NUECES LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	LIVE OAK	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	MCMULLEN	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	NUECES	NUECES	FRESH	0	0	0	0	0	0
NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	NUECES	FRESH	0	0	0	0	0	0
NUECES RUN-OF-RIVER	LIVE OAK	NUECES	FRESH	0	0	0	0	0	0
NUECES RUN-OF-RIVER	NUECES	NUECES	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	BROOKS	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	DUVAL	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	JIM WELLS	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
NUECES-RIO GRANDE LIVESTOCK LOCAL SUPPLY	NUECES	NUECES-RIO GRANDE	FRESH	2	2	2	2	2	2
NUECES-RIO GRANDE RUN-OF-RIVER	NUECES	NUECES-RIO GRANDE	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	ARANSAS	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	BEE	SAN ANTONIO-NUECES	FRESH	420	420	420	420	420	420
SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	BEE	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SAN ANTONIO-NUECES RUN-OF-RIVER	SAN PATRICIO	SAN ANTONIO-NUECES	FRESH	0	0	0	0	0	0
SURFACE WATER TOTAL SOURCE WATER BALANCE				**494**	**494**	**494**	**494**	**494**	**494**

REGION N TOTAL SOURCE WATER BALANCE	**88,009**	**102,028**	**111,609**	**126,304**	**131,027**	**131,365**

*Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

Appendix A: DB 22 Report #10a- WUG Data Comparison to 2016 RWP

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Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARANSAS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,446	491	-66.0%	1,342	455	-66.1%
PROJECTED DEMAND TOTAL	1,446	491	-66.0%	1,342	455	-66.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	44	56	27.3%	44	56	27.3%
PROJECTED DEMAND TOTAL	44	56	27.3%	44	56	27.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	265	0	-100.0%	265	0	-100.0%
PROJECTED DEMAND TOTAL	137	0	-100.0%	172	0	-100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	10	10	0.0%	10	5	-50.0%
PROJECTED DEMAND TOTAL	10	10	0.0%	5	5	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
ARANSAS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,065	3,594	74.0%	2,025	3,524	74.0%
PROJECTED DEMAND TOTAL	2,065	3,594	74.0%	2,025	3,524	74.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BEE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,770	218	-92.1%	2,770	218	-92.1%
PROJECTED DEMAND TOTAL	2,725	1,875	-31.2%	2,721	1,872	-31.2%
WATER SUPPLY NEEDS TOTAL	0	1,657	100.0%	0	1,654	100.0%
BEE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	8,025	4,073	-49.2%	8,025	4,073	-49.2%
PROJECTED DEMAND TOTAL	4,751	4,425	-6.9%	7,985	4,425	-44.6%
WATER SUPPLY NEEDS TOTAL	0	352	100.0%	0	352	100.0%
BEE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	930	834	-10.3%	930	834	-10.3%
PROJECTED DEMAND TOTAL	930	834	-10.3%	930	834	-10.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BEE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1	0	-100.0%	1	0	-100.0%
PROJECTED DEMAND TOTAL	1	0	-100.0%	1	0	-100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BEE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	510	275	-46.1%	510	256	-49.8%
PROJECTED DEMAND TOTAL	472	472	0.0%	318	318	0.0%
WATER SUPPLY NEEDS TOTAL	0	197	100.0%	0	62	100.0%
BEE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,068	4,293	39.9%	3,103	4,332	39.6%
PROJECTED DEMAND TOTAL	3,008	4,564	51.7%	3,040	4,625	52.1%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	271	100.0%	0	293	100.0%
BROOKS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	450	32	-92.9%	450	32	-92.9%
PROJECTED DEMAND TOTAL	326	224	-31.3%	449	341	-24.1%
WATER SUPPLY NEEDS TOTAL	0	192	100.0%	0	309	100.0%
BROOKS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,300	1,161	-49.5%	2,300	1,161	-49.5%
PROJECTED DEMAND TOTAL	1,800	1,161	-35.5%	2,297	1,161	-49.5%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	620	463	-25.3%	620	463	-25.3%
PROJECTED DEMAND TOTAL	620	463	-25.3%	620	463	-25.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	1	100.0%	0	1	100.0%
PROJECTED DEMAND TOTAL	0	1	100.0%	0	1	100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
BROOKS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	360	178	-50.6%	360	178	-50.6%
PROJECTED DEMAND TOTAL	357	357	0.0%	298	298	0.0%
WATER SUPPLY NEEDS TOTAL	0	179	100.0%	0	120	100.0%
BROOKS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,697	1,639	-39.2%	2,697	1,852	-31.3%
PROJECTED DEMAND TOTAL	1,677	1,639	-2.3%	1,915	1,852	-3.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	650	0	-100.0%	650	0	-100.0%
PROJECTED DEMAND TOTAL	549	477	-13.1%	610	516	-15.4%
WATER SUPPLY NEEDS TOTAL	0	477	100.0%	0	516	100.0%
DUVAL COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,900	4,042	3.6%	3,900	4,042	3.6%
PROJECTED DEMAND TOTAL	3,004	4,042	34.6%	3,834	4,042	5.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	754	640	-15.1%	754	640	-15.1%
PROJECTED DEMAND TOTAL	754	640	-15.1%	754	640	-15.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
DUVAL COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	4,656	676	-85.5%	4,656	676	-85.5%
PROJECTED DEMAND TOTAL	1,388	1,388	0.0%	1,104	1,104	0.0%
WATER SUPPLY NEEDS TOTAL	0	712	100.0%	0	428	100.0%
DUVAL COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,024	1,406	-30.5%	2,024	1,544	-23.7%
PROJECTED DEMAND TOTAL	1,610	1,694	5.2%	1,858	1,961	5.5%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	288	100.0%	107	417	289.7%
JIM WELLS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,430	37	-98.9%	3,430	37	-98.9%
PROJECTED DEMAND TOTAL	2,634	2,095	-20.5%	3,360	2,687	-20.0%
WATER SUPPLY NEEDS TOTAL	0	2,058	100.0%	0	2,650	100.0%
JIM WELLS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,300	1,580	-52.1%	3,300	1,580	-52.1%
PROJECTED DEMAND TOTAL	2,500	1,913	-23.5%	3,191	1,913	-40.1%
WATER SUPPLY NEEDS TOTAL	0	333	100.0%	0	333	100.0%
JIM WELLS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,029	902	-12.3%	1,029	902	-12.3%
PROJECTED DEMAND TOTAL	1,029	902	-12.3%	1,029	902	-12.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
JIM WELLS COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	79	100.0%	0	79	100.0%
PROJECTED DEMAND TOTAL	0	79	100.0%	0	95	100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	16	100.0%
JIM WELLS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	74	19	-74.3%	74	16	-78.4%
PROJECTED DEMAND TOTAL	71	71	0.0%	17	17	0.0%
WATER SUPPLY NEEDS TOTAL	0	52	100.0%	0	1	100.0%
JIM WELLS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	7,016	5,984	-14.7%	8,245	7,747	-6.0%
PROJECTED DEMAND TOTAL	5,464	5,984	9.5%	7,084	7,747	9.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	51	0	-100.0%
KENEDY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	305	244	-20.0%	305	263	-13.8%
PROJECTED DEMAND TOTAL	244	244	0.0%	264	263	-0.4%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
KENEDY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	644	735	14.1%	644	735	14.1%
PROJECTED DEMAND TOTAL	644	735	14.1%	644	735	14.1%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
KENEDY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	130	60	-53.8%	130	27	-79.2%
PROJECTED DEMAND TOTAL	118	118	0.0%	27	27	0.0%
WATER SUPPLY NEEDS TOTAL	0	58	100.0%	0	0	0.0%
KLEBERG COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	3,633	257	-92.9%	3,633	349	-90.4%
PROJECTED DEMAND TOTAL	601	257	-57.2%	817	349	-57.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
KLEBERG COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	800	850	6.3%	800	850	6.3%
PROJECTED DEMAND TOTAL	600	850	41.7%	766	850	11.0%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
KLEBERG COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,276	673	-47.3%	1,276	673	-47.3%
PROJECTED DEMAND TOTAL	1,276	673	-47.3%	1,276	673	-47.3%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
KLEBERG COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	1,809	100.0%	0	1,809	100.0%
PROJECTED DEMAND TOTAL	0	1,809	100.0%	0	2,056	100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	247	100.0%
KLEBERG COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	380	218	-42.6%	380	218	-42.6%
PROJECTED DEMAND TOTAL	357	357	0.0%	298	298	0.0%
WATER SUPPLY NEEDS TOTAL	0	139	100.0%	0	80	100.0%
KLEBERG COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	4,929	5,152	4.5%	6,159	6,892	11.9%
PROJECTED DEMAND TOTAL	4,573	5,152	12.7%	6,090	6,892	13.2%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,002	637	-36.4%	1,002	602	-39.9%
PROJECTED DEMAND TOTAL	802	637	-20.6%	758	602	-20.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,900	1,287	-55.6%	2,900	1,096	-62.2%
PROJECTED DEMAND TOTAL	2,200	1,630	-25.9%	2,808	1,630	-42.0%
WATER SUPPLY NEEDS TOTAL	0	343	100.0%	0	534	100.0%
LIVE OAK COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	933	740	-20.7%	933	740	-20.7%
PROJECTED DEMAND TOTAL	933	740	-20.7%	933	740	-20.7%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	5,054	2,274	-55.0%	5,054	2,465	-51.2%
PROJECTED DEMAND TOTAL	2,024	2,274	12.4%	2,333	2,493	6.9%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	28	100.0%
LIVE OAK COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	920	814	-11.5%	920	332	-63.9%
PROJECTED DEMAND TOTAL	814	814	0.0%	332	332	0.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
LIVE OAK COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,507	1,188	-52.6%	2,507	1,111	-55.7%
PROJECTED DEMAND TOTAL	944	1,179	24.9%	882	1,101	24.8%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	546	97	-82.2%	546	89	-83.7%
PROJECTED DEMAND TOTAL	97	97	0.0%	90	89	-1.1%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | IRRIGATION WUG TYPE						
PROJECTED DEMAND TOTAL	40	0	-100.0%	51	0	-100.0%
WATER SUPPLY NEEDS TOTAL	40	0	-100.0%	51	0	-100.0%
MCMULLEN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	355	335	-5.6%	355	335	-5.6%
PROJECTED DEMAND TOTAL	355	335	-5.6%	355	335	-5.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	219	100.0%	0	249	100.0%
PROJECTED DEMAND TOTAL	0	219	100.0%	0	249	100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
MCMULLEN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,535	4,268	178.0%	1,535	1,305	-15.0%
PROJECTED DEMAND TOTAL	4,268	4,268	0.0%	1,305	1,305	0.0%
WATER SUPPLY NEEDS TOTAL	2,733	0	-100.0%	0	0	0.0%
NUECES COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	2,042	230	-88.7%	2,096	303	-85.5%
PROJECTED DEMAND TOTAL	1,554	1,475	-5.1%	2,093	1,667	-20.4%
WATER SUPPLY NEEDS TOTAL	0	1,245	100.0%	0	1,364	100.0%
NUECES COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	701	1,489	112.4%	701	1,489	112.4%
PROJECTED DEMAND TOTAL	439	1,540	250.8%	560	1,540	175.0%
WATER SUPPLY NEEDS TOTAL	0	51	100.0%	0	51	100.0%
NUECES COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	315	291	-7.6%	315	291	-7.6%
PROJECTED DEMAND TOTAL	315	291	-7.6%	315	291	-7.6%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
NUECES COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	50,276	46,822	-6.9%	48,166	23,342	-51.5%
PROJECTED DEMAND TOTAL	50,276	45,411	-9.7%	67,769	50,363	-25.7%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	19,603	27,021	37.8%
NUECES COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	724	95	-86.9%	1,260	133	-89.4%
PROJECTED DEMAND TOTAL	724	724	0.0%	1,260	1,260	0.0%
WATER SUPPLY NEEDS TOTAL	0	629	100.0%	0	1,127	100.0%
NUECES COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	70,034	69,306	-1.0%	80,902	80,829	-0.1%
PROJECTED DEMAND TOTAL	71,617	73,433	2.5%	82,427	84,922	3.0%
WATER SUPPLY NEEDS TOTAL	1,583	4,127	160.7%	1,525	4,093	168.4%
NUECES COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	15,038	2,077	-86.2%	27,648	2,077	-92.5%
PROJECTED DEMAND TOTAL	15,038	2,077	-86.2%	34,541	2,077	-94.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	6,893	0	-100.0%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region N Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)*

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
SAN PATRICIO COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	1,584	843	-46.8%	1,705	908	-46.7%
PROJECTED DEMAND TOTAL	1,584	843	-46.8%	1,705	908	-46.7%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL	14,441	14,441	0.0%	14,441	14,441	0.0%
PROJECTED DEMAND TOTAL	11,085	14,645	32.1%	18,632	14,645	-21.4%
WATER SUPPLY NEEDS TOTAL	0	204	100.0%	4,191	204	-95.1%
SAN PATRICIO COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL	406	396	-2.5%	406	396	-2.5%
PROJECTED DEMAND TOTAL	406	396	-2.5%	406	396	-2.5%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	33,286	36,555	9.8%	38,462	35,959	-6.5%
PROJECTED DEMAND TOTAL	39,737	38,841	-2.3%	56,991	43,223	-24.2%
WATER SUPPLY NEEDS TOTAL	6,451	2,286	-64.6%	18,529	7,264	-60.8%
SAN PATRICIO COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL	565	135	-76.1%	565	135	-76.1%
PROJECTED DEMAND TOTAL	372	372	0.0%	533	533	0.0%
WATER SUPPLY NEEDS TOTAL	0	237	100.0%	0	398	100.0%
SAN PATRICIO COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL	9,127	9,412	3.1%	9,446	9,875	4.5%
PROJECTED DEMAND TOTAL	8,561	9,412	9.9%	8,980	9,875	10.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
SAN PATRICIO COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL	0	1,919	100.0%	0	1,919	100.0%
PROJECTED DEMAND TOTAL	0	1,919	100.0%	0	1,919	100.0%
WATER SUPPLY NEEDS TOTAL	0	0	0.0%	0	0	0.0%
REGION N						
EXISTING WUG SUPPLY TOTAL	278,782	238,551	-14.4%	308,706	226,940	-26.5%
PROJECTED DEMAND TOTAL	261,970	253,218	-3.3%	343,244	276,492	-19.4%
WATER SUPPLY NEEDS TOTAL	10,807	16,087	48.9%	50,950	49,562	-2.7%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Appendix A: DB 22 Report #10b- Source Data Comparison to 2016 RWP

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Region N Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARANSAS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	1,862	1,542	-17.2%	1,862	1,542	-17.2%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	21	33	57.1%	21	33	57.1%
BEE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	20,568	18,437	-10.4%	20,492	20,973	2.3%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	464	464	0.0%	464	464	0.0%
BROOKS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	15,595	5,582	-64.2%	15,595	7,892	-49.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	160	125	-21.9%	160	125	-21.9%
DUVAL COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	14,063	20,571	46.3%	14,063	26,963	91.7%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	148	30	-79.7%	148	30	-79.7%
JIM WELLS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	27,886	9,144	-67.2%	27,886	11,017	-60.5%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	402	212	-47.3%	402	212	-47.3%
KENEDY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	51,778	13,301	-74.3%	51,778	29,261	-43.5%
KLEBERG COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	50,701	10,365	-79.6%	50,701	18,711	-63.1%
LIVE OAK COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	13,833	8,338	-39.7%	13,833	8,441	-39.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,752	1,711	-2.3%	1,752	1,711	-2.3%
MCMULLEN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	2,734	7,789	184.9%	2,734	5,138	87.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	262	279	6.5%	262	295	12.6%
NUECES COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	9,009	6,589	-26.9%	9,009	7,924	-12.0%
REUSE AVAILABILITY TOTAL (acre-feet per year)	1,140	1,213	6.4%	1,140	1,213	6.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,991	436	-78.1%	1,991	436	-78.1%
RESERVOIR COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	150,160	106,560	-29.0%	143,160	95,360	-33.4%
SAN PATRICIO COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	19,013	43,611	129.4%	19,013	49,234	158.9%
REUSE AVAILABILITY TOTAL (acre-feet per year)	2,688	2,688	0.0%	2,688	2,688	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	115	163	41.7%	115	163	41.7%
REGION N						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	227,042	145,269	-36.0%	226,966	187,096	-17.6%
REUSE AVAILABILITY TOTAL (acre-feet per year)	3,828	3,901	1.9%	3,828	3,901	1.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	155,475	110,013	-29.2%	148,475	98,829	-33.4%

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Appendix B

Hydrologic Variance Request(s) and
TWDB Approval Letters

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Appendix B: Hydrologic Variance Request(s) and TWDB Approval Letters

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Coastal Bend Regional Water Planning Group

602 N. Staples Street Suite 280, Corpus Christi, Texas 78401
Phone: 361-653-2110; Fax: 361-653-2115

September 22, 2017

Jeff Walker
Executive Administrator
Texas Water Development Board
Stephen F. Austin Bldg.
P.O. Box 13231
Austin, Texas 78711-3231

RE: Request for Hydrologic Variance to Use the Corpus Christi Water Supply Model to Evaluate Water Availability for the Choke Canyon Reservoir/ Lake Corpus Christi/ Lake Texana/Colorado River (CCR/LCC/Lake Texana/MRP Phase II) System **AND** Request for Approval to Report Water Availability for this Multi-Basin Regional Supply as a System rather than Individual Reservoirs

Dear Mr. Walker:

The City of Corpus Christi and other regional wholesale water providers supply nearly 90% of the Coastal Bend Regional water needs with supplies from the Choke Canyon Reservoir/ Lake Corpus Christi/ Lake Texana/Colorado River (CCR/LCC/Lake Texana/MRP Phase II) System. The multi-basin system presents a unique situation for managing reservoir operations and determining available supply based on permitting and contract relationships in conjunction with variable hydrology by basin. This complex system and the TCEQ Agreed Order (2001) that governs the passage of inflow through the system to the Nueces Bay and Estuary led to development of the Corpus Christi Water Supply Model, originally developed as the Nueces Bay and Estuary Model in 1991.

According to TWDB Guidelines[1] for 2021 Regional Plan Development, "planning groups are required to use TCEQ's unmodified WAM Run #3 to estimate surface water availability unless the TWDB Executive Administrator has approved use of other models." On August 10, 2017, the Coastal Bend Regional Water Planning Group (CBRWPG) approved that a request be sent to the TWDB for approval to use the Corpus Christi Water Supply Model to estimate surface water availability for the CCR/LCC/Lake Texana/MRP Phase II System for the 2021 Coastal Bend Regional Water Plan. For all other water rights except the CCR/LCC/Lake Texana/MRP Phase II System, the unmodified WAM Run #3 would be used.

[1] Texas Water Development Board, First Amended General Guidelines for Fifth Cycle of Regional Water Plan Development, April 2017.

At the same meeting, on August 10th, the CBRWPG approved that a request be sent to the TWDB for approval to allow the CCR/LCC/Lake Texana/MRP Phase II System to be evaluated and reported as a reservoir *system*[2] for the 2021 Coastal Bend Regional Water Plan. Reporting by individual reservoirs is problematic and misleading, since it does not appropriately reflect the City's reservoir operation policy nor account for system gains.

The Corpus Christi Water Supply Model incorporates data from the Nueces WAM, however it also includes and operates the Lavaca, and portions of the Colorado in a conjunctive manner and includes extended hydrology through 2015. **The use of the Corpus Christi Water Supply Model is important to the Region since it includes the most recent drought and enables the reservoirs to be operated as a system according to permit and contract allowances to calculate supplies made available by both firm and interruptible water from Lake Texana and supplies from the Lower Colorado River.**

All previous Region N Plans have used the Corpus Christi Water Supply Model to determine water availability for the multi-basin regional water supply system. The TWDB, City of Corpus Christi, and other stakeholders have continued to invest in the Corpus Christi Water Supply Model since inception of the model in 1991, including a recent update by the City of Corpus Christi to include:

- Hydrology through 2015 to include the most recent drought of record for a total model period of 82 years (1934 to 2015)
- New TWDB volumetric survey data for Lake Corpus Christi and Choke Canyon Reservoir with updated sedimentation rates
- Recent hydrology for Lake Texana and Colorado River (MRP Phase II)

The TCEQ Nueces River Basin WAM simulates hydrologic conditions from 1934 to 1996 and does not include the most recent drought of record. Furthermore, the TCEQ Nueces Basin WAM Run # 3 does not accurately simulate the City's reservoir operating system because it does not include existing water supplies from the east (i.e. Lake Texana and Colorado River).

The Coastal Bend Regional Water Planning Group requests (1) approval to use the Corpus Christi Water Supply Model for developing the 2021 Plan to estimate the yield of the CCR/LCC/Lake Texana/MRP Phase II System and (2) approval to report its supply as a *reservoir system* rather than individual reservoirs.

The TWDB formula-based funding allocation for Task 3 included in the Regional Water Planning Grant Application published in the Texas Register provides suitable funds to use the Corpus Christi Water Supply Model to evaluate water supplies and water management strategies. If not approved, the surface water supply evaluation effort to use and adapt the WAM(s) for 2021 Coastal Bend Regional Water Plan development will require substantial cost revisions beyond the TWDB's allocated budget.

Thank you for your consideration of this important request. Please contact me at 361-653-2110 with any questions or comments.

2 As specified in Attachment 1- Exhibit A TWDB- Fifth Cycle of Regional Water Planning First Amended Scope of Work, "Reservoir systems must be approved by TWDB."

Sincerely,

Rocky Freund

Rocky Freund
Deputy Executive Director
Nueces River Authority

CC: Carola Serrato, Co-Chair CBRWPG
Scott Bledsoe, Co-Chair CBRWPG
Temple McKinnon, TWDB
Connie Townsend, TWDB
Kristi Shaw, HDR Engineering

Coastal Bend Regional Water Planning Group

602 N. Staples Street Suite 280, Corpus Christi, Texas 78401
Phone: 361-653-2110; Fax: 361-653-2115

September 22, 2017

Jeff Walker
Executive Administrator
Texas Water Development Board
Stephen F. Austin Bldg.
P.O. Box 13231
Austin, Texas 78711-3231

RE: Request for Approval to Use Safe Yield as the Basis for Determining Available Surface Water Supplies from the Choke Canyon Reservoir/ Lake Corpus Christi/ Lake Texana/Colorado River (CCR/LCC/Lake Texana/MRP Phase II) System for the 2021 Coastal Bend Regional Water Plan

Dear Mr. Walker:

The Coastal Bend Regional Water Planning Group (CBRWPG) requests TWDB approval of a hydrologic variance to grant the use of safe yield for planning and determining surface water availability from the Choke Canyon Reservoir/ Lake Corpus Christi/ Lake Texana/Colorado River (CCR/LCC/Lake Texana/MRP Phase II) System. The CBRWPG approved submittal of this request at its regularly scheduled, public meeting on August 10, 2017.

According to TWDB Guidelines[1] for 2021 Regional Plan Development, "planning groups should analyze existing available surface water supplies based on firm yield for reservoirs and run of river diversions, unless otherwise approved by the TWDB's Executive Administrator." In accordance with TWDB guidance, firm yield will be reported in the technical memorandum, Initially Prepared Plan, and 2021 Regional Water Plan. However, if the hydrologic variance requested by this letter is granted, then safe yield will be used to evaluate existing water supply availability from the CCR/LCC/Lake Texana/MRP Phase II System for development of the Coastal Bend Regional Water Plan. All other surface water supplies will be reported based on firm yield.

Choke Canyon Reservoir and Lake Corpus Christi in the Nueces Basin operate together in a system to provide water supplies to the City of Corpus Christi (City) and their customers. Together with Lake Texana and Colorado River supplies, the CCR/LCC/Lake Texana/MRP Phase II system provides surface water supplies to meet nearly 90% of the overall water demands in the Coastal Bend Region. The Nueces Basin portion of the regional water supply system is prone to severe drought. Average annual inflows to the Lake Corpus Christi and Choke Canyon System in the Nueces Basin is lower with each successive

1 Texas Water Development Board, "First Amended General Guidelines for Fifth Cycle of Regional Water Plan Development, April 2017.

drought. The single lowest inflow year was 2011, however based on calendar year the most recent average three year inflow was comparable to the 1990s, as shown in the Attachment. When the minimum 3 year inflow periods (not constrained by calendar) are considered, less inflow is observed during more recent times. If we look at two year inflow minimums, there are two, two-year events during the most recent decade where inflows were less than 50% of the historical minimum two year average (from 1934-2013).

A recent hydrology update to the Corpus Christi Water Supply Model (through 2015) shows that the current drought is a new drought of record for the region. Choke Canyon Reservoir and Lake Corpus Christi have not been full (i.e. 100% conservation pool) since September 2007. For this reason, safe yield is more reasonable than firm yield for drought planning purposes as a provision for climate uncertainty. Safe yield planning reduces the annual availability volume from the CCR/LCC/Lake Texana/MRP Phase II System as compared to the firm yield availability estimate, and will consequently move up any identified water needs to earlier decades than with use of firm yield.

The Coastal Bend Regional Water Planning Group requests that the TWDB approve the use of safe yield analyses for the CCR/LCC/Lake Texana/MRP Phase II System for developing the 2021 Coastal Bend Regional Water Plan. The previous Coastal Bend Regional Water Plans (2006, 2011, and 2016) have all used safe yield for water supply planning for the multi-basin regional water supply system.

Thank you for your consideration of this important request. Please contact me at 361-653-2110 with any questions or comments.

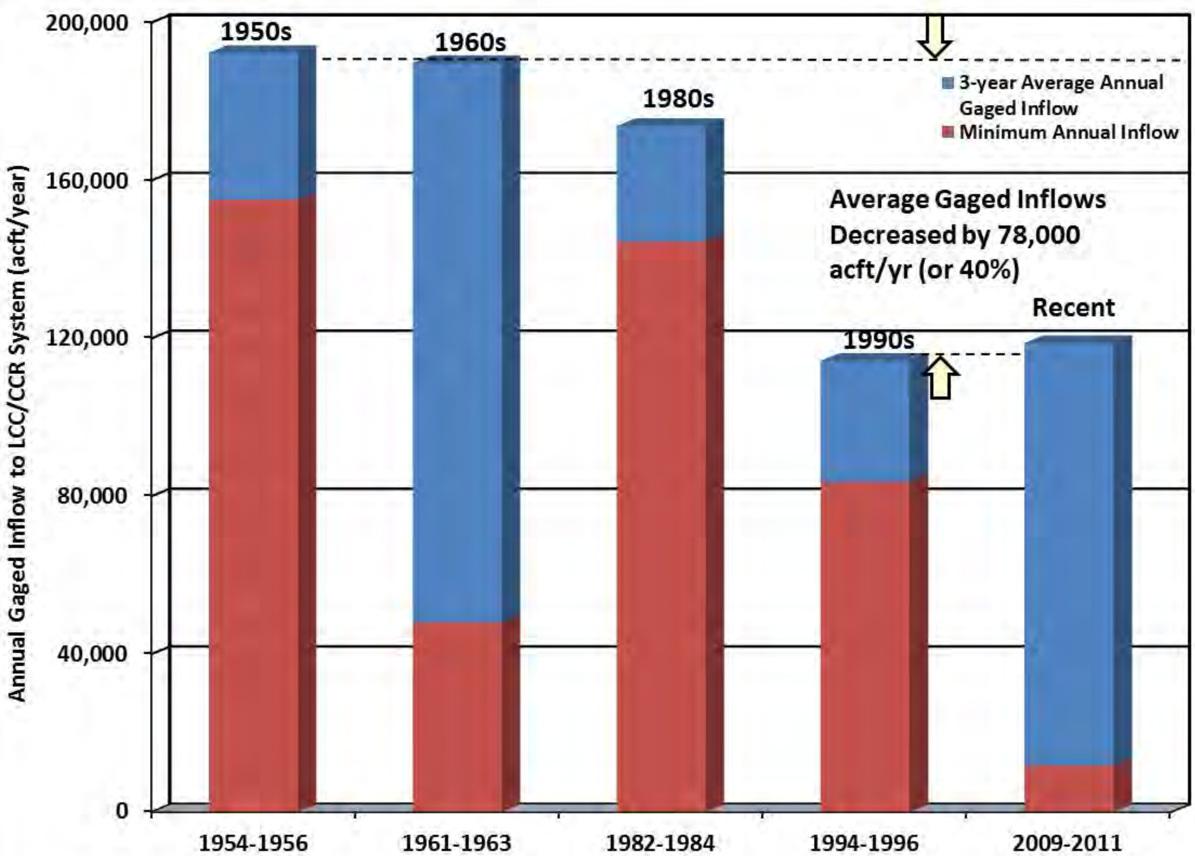
Sincerely,

Rocky Freund

Rocky Freund
Deputy Executive Director
Nueces River Authority

CC: Carola Serrato, Co-Chair CBRWPG
Scott Bledsoe, Co-Chair CBRWPG
Temple McKinnon, TWDB
Connie Townsend, TWDB
Kristi Shaw, HDR Engineering

ATTACHMENT



Historical 3 Year Reservoir Inflows

Source: 2016 Coastal Bend Regional Water Plan

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

January 5, 2018

Ms. Rocky Freund
Deputy Executive Director
Nueces River Authority
602 N. Staples St, #280
Corpus Christi, Texas 78401

RE: Region N Regional Water Planning Group (RWPG) requests for approval to modify existing surface water availability hydrologic assumptions for development of the 2021 Region N Regional Water Plan (RWP)

Dear Ms. Freund:

The Texas Water Development Board (TWDB) has reviewed your requests dated September 22, 2017 for approval of alternative water supply assumptions to be used in determining existing surface water availability. This letter confirms that the TWDB approves the following:

1. Use of the Corpus Christi Water Supply Model to estimate surface water availability for the Choke Canyon Reservoir (CCR)/Lake Corpus Christi (LLC)/Lake Texana/MRP Phase II System.
2. Use of safe yield for planning and determining surface water availability from the CCR/LLC/Lake Texana/MRP Phase II System.

The RWPG also requested approval to report surface water availability for the CCR/LLC/Lake Texana/MRP Phase II System rather than by individual reservoirs. This assumption is allowable under existing regional water planning guidance.

We understand that for all water rights except those for the CCR/LCC/Lake Texana/MRP Phase II System, Region N will use the Texas Commission on Environmental Quality's (TCEQ) Water Availability Model (WAM) RUN3 with full diversions and no return flows and firm yields of reservoirs for evaluating the availability associated with these other water rights.

Although the TWDB approves the use of a one-year safe yield for developing estimates of current water supplies for the CCR/LCC/Lake Texana/MRP Phase II System, firm yield for the system must still be reported to TWDB in the online planning database and plan documents.

For the purpose of evaluating potentially feasible water management strategies, the TCEQ WAM RUN3 is to be used.

While the TWDB authorizes these modifications to evaluate existing water supplies for development of the 2021 Region N RWP, it is the responsibility of the RWPG to ensure that the resulting estimates of water availability are reasonable for drought planning purposes and will reflect conditions expected in the event of actual drought conditions; and in all other regards will be evaluated in accordance with the contract Exhibit C, *General Guidelines for Fifth Cycle of Regional Water Plan Development.*

If you have any questions, please do not hesitate to contact Connie Townsend, project manager for Region N, at 512-463-8290 or via email at connie.townsend@twdb.texas.gov.

Sincerely,

Jeff Walker
Executive Administrator

c: Carola Serrato, Co-Chair
Scotty Bledsoe, Co-Chair
Kristi Shaw, Consultant
Connie Townsend, Project Manager

Appendix D

Model Water Conservation Plans and Drought Contingency Plans (Region Specific)

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Model Water Conservation Plans

For municipal water users, the CBRWPG compiled a summary of frequent best management practices and water conservation goals (5 year and 10 year) from existing water conservation plans submitted to the TCEQ for water user groups in the Coastal Bend Region. The CBRWPG recommends appending these region specific tables, beginning on the next page, with the TCEQ model water conservation form (also attached). The TCEQ form can also be accessed electronically on the TCEQ website at:
https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html

Municipal water user groups in the area seeking to develop a water conservation plan are encouraged to consider the attached information from the CBRWPG as a guide. However, a one-size-fits-all approach is often impractical for all municipal water utilities and accordingly, it is to the discretion of the utility to develop a water conservation approach and target goals that serves its utility the best.

Summary of Water Conservation BMPs in the Coastal Bend Region

Wholesale Water Provider	WCP Available	Date	Best Management Practices: Reduce Water Losses/ Unaccounted for Water/Leak Detection	Water Conservation Pricing/Seasonal or Inverted Block Rates	Reuse	Improve Meter Accuracy	Toilet Replacement/ Retrofit Programs	Public/School Education	Landscape Conservation/ Xeriscape	Others
City of Corpus Christi[1]	Y	2019	√	√	√	√		√	√	√
San Patricio Municipal Water District[1]	Y	2019	√	√	√	√		√	√	√
South Texas Water Authority[1]	Y	2018	√	√		√		√		
Nueces County WCID 3[1,2]	Y	2019	√	√	√	√	√	√		
Water User Group										
Alice[1]	Y	2019	√	√	√	√		√	√	
Aransas Pass[2]	Y	2008	√	√		√	√	√	√	
Beeville	Y	2020	√	√	√	√		√		
El Oso WSC	Y	2009	√	√		√		√		√
Falfurrias	Y	1999	√	√		√		√	√	
Holiday Beach WSC	Y	2018	√	√	√	√	√		√	
Ingleside	Y	2018	√	√	√	√		√	√	√
Kingsville[2]	Y	2018	√	√	√	√		√	√	
McCoy WSC[2]	Y	2014	√	√		√		√		
Nueces County WCID 4[1]	Y	2019	√	√	√	√		√	√	
Nueces WSC[1]	Y	2019	√	√		√		√		
Odem[1]	Y	2013	√	√		√		√	√	√
Portland[1]	Y	2015	√	√	√	√	√	√	√	
Ricardo WSC[1]	Y	2018	√	√		√		√		
Robstown[2]	Y	2011						√		
Rockport[2]	Y	2015	√	√	√	√				
Taft[1]	Y	2013	√	√	√	√	√	√	√	
Three Rivers[2]	Y	2019	√	√	√	√		√	√	√

[1] Water Conservation Plan on-file with the Nueces River Authority.
[2] Water Conservation Plan provided by the TWDB.

Summary of 5 and 10 Year Water Conservation Goals in the Coastal Bend Region

Wholesale Water Provider	5-Year Goal GPCD Target	5-Year Goal General	10-Year Goal GPCD Target	10-Year Goal General
City of Corpus Christi[1,2,3]	195[2]	1% annual reduction over next decade	184[2]	1% annual reduction over next decade
San Patricio Municipal Water District[1]	141	1% annual reduction over next decade	134	1% annual reduction over next decade
South Texas Water Authority[1]	140-145	Not Available	140-145	Not Available
Nueces County WCID 3[1,2]	103	Not Available	108	Not Available
Water User Group				
Alice[1,2]	176	Reduce per capita use by 3%	173	Reduce per capita use by 3%
Aransas Pass[2]	225	2.5% per capita	260	5% per capita
Beeville	161	1% annual reduction over next decade	160	1% annual reduction over next decade
Corpus Christi[1,2,3]	195	1% annual reduction over next decade	184	1% annual reduction over next decade
El Oso WSC	N/A	Reduce water loss	N/A	Reduce water loss
Falfurrias	N/A	Not Available	N/A	Not Available
Holiday Beach WSC	58	Reduce water loss	56	Reduce water loss
Ingleside	106	1% reduction in water loss and usage within the next 5 years	105	2% within the next 10 years
Kingsville[2]	130	1% annual reduction	125	1% annual reduction
McCoy WSC[1]	115	Maintain current per capita usage; Reduce water loss to 4% of water pumped, line flushing and fire fighting	110	Reduce usage by 4.5%; Reduce water loss to 2% of water pumped, not including line flushing and fire fighting
Nueces County WCID 4[1,2]	396	1% annual reduction over next decade	376	1% annual reduction over next decade
Nueces WSC[1]	118	Maintain current per capita usage	118	Maintain current per capita usage
Odem[1]	149	5% over the next 10 years	146	7% reduction in unaccounted-for water over the next 10 years
Portland[1]	272	5% reduction	258	10% reduction
Ricardo WSC[1]	95	Maintain current per capita usage	95	Maintain current per capita usage
Robstown[2]	N/A	Not Available	N/A	Not Available
Rockport	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands
Taft[1,2]	147	Reduce per capita use by 3%	140	Reduce per capita use by 3%
Three Rivers[2,3]	386	0.5% annual reduction	377	0.5% annual reduction

[1] Water Conservation Plan on-file with the Nueces River Authority.
[2] Information is from the 2019 Water Conservation Plans, Target and Goal Table, provided by the TWDB.
[3] Calculated by taking volume of treated water, excluding water sold to wholesale customers, and dividing by permanent population, divided by 365. Because industrial use is close to 40% of treated water, the per capita rate is higher. Target goal for residential use is 73 gpcd (2018) and 69 gpcd (Year 2023).
N/A = Not Available

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Texas Commission on Environmental Quality
Water Availability Division
MC-160, P.O. Box 13087 Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-2214

Utility Profile and Water Conservation Plan Requirements for Municipal Water Use by Retail Public Water Suppliers

This form is provided to assist retail public water suppliers in water conservation plan assistance in completing this form or in developing your plan, please contact the Conservation staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Water users can find best management practices (BMPs) at the Texas Water Development Board's website http://www.twdb.texas.gov/conservation/BMPs/index.asp. The practices are broken out into sectors such as Agriculture, Commercial and Institutional, Industrial, Municipal and Wholesale. BMPs are voluntary measures that water users use to develop the required components of Title 30, Texas Administrative Code, Chapter 288. BMPs can also be implemented in addition to the rule requirements to achieve water conservation goals.

Contact Information

Name of Water Supplier:	Click to add text	
Address:		
Telephone Number:	( )	Fax: ( )
Water Right No.(s):		
Regional Water Planning Group:		
Water Conservation Coordinator (or person responsible for implementing conservation program):		Phone: ( )
Form Completed by:		
Title:		
Signature:		Date: / /

A water conservation plan for municipal use by retail public water suppliers must include the following requirements (as detailed in 30 TAC Section 288.2). If the plan does not provide information for each requirement, you must include in the plan an explanation of why the requirement is not applicable.

Utility Profile

I. POPULATION AND CUSTOMER DATA

A. Population and Service Area Data

1. Attach a copy of your service-area map and, if applicable, a copy of your Certificate of Convenience and Necessity (CCN).
2. Service area size (in square miles):

   (Please attach a copy of service-area map)
3. Current population of service area:
4. Current population served for:
   a. Water
   b. Wastewater

5. Population served for previous five years:

Year	Population

6. Projected population for service area in the following decades:

Year	Population
2020	
2030	
2040	
2050	
2060	

7. List source or method for the calculation of current and projected population size.

B. Customer Data

Senate Bill 181 requires that uniform consistent methodologies for calculating water use and conservation be developed and available to retail water providers and certain other water use sectors as a guide for preparation of water use reports, water conservation plans, and reports on water conservation efforts. A water system must provide the most detailed level of customer and water use data available to it, however, any new billing system purchased must be capable of reporting data for each of the sectors listed below. More guidance can be found at: http://www.twdb.texas.gov/conservation/doc/SB181Guidance.pdf

1. Quantified 5-year and 10-year goals for water savings:

	Historic 5–year Average	*Baseline*	*5–year goal for year*	*10–year goal for year*
Total GPCD				
Residential GPCD				
Water Loss GPCD				
Water Loss Percentage				

Notes:
Total GPCD = (Total Gallons in System ÷ Permanent Population) ÷ 365
Residential GPCD = (Gallons Used for Residential Use ÷ Residential Population) ÷ 365
Water Loss GPCD = (Total Water Loss ÷ Permanent Population) ÷ 365
Water Loss Percentage = (Total Water Loss ÷ Total Gallons in System) x 100; or (Water Loss GPCD ÷ Total GPCD) x 100

2. Current number of active connections. Check whether multi-family service is counted as ☐ Residential or ☐ Commercial?

Treated Water Users	*Metered*	*Non–Metered*	*Totals*
Residential			
Single-Family			
Multi-Family			
Commercial			
Industrial/Mining			
Institutional			
Agriculture			
Other/Wholesale			

3. List the number of new connections per year for most recent three years.

Year			
Treated Water Users			
Residential			
Single-Family			
Multi-Family			
Commercial			
Industrial/Mining			
Institutional			
Agriculture			
Other/Wholesale			

4. List of annual water use for the five highest volume customers.

Customer	Use (1,000 gal/year)	Treated or Raw Water

II. WATER USE DATA FOR SERVICE AREA

A. Water Accounting Data

1. List the amount of water use for the previous five years (in 1,000 gallons).

   Indicate whether this is ☐ diverted or ☐ treated water.

Year					
Month					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Totals					

2. Describe how the above figures were determined (e.g, from a master meter located at the point of a diversion from the source or located at a point where raw water enters the treatment plant, or from water sales).

3. Amount of water (in 1,000 gallons) delivered/sold as recorded by the following account types for the past five years.

Year					
Account Types					
Residential					
Single-Family					
Multi-Family					
Commercial					
Industrial/Mining					
Institutional					
Agriculture					
Other/Wholesale					

4. List the previous records for water loss for the past five years (the difference between water diverted or treated and water delivered or sold).

Year	*Amount (gallons)*	*Percent %*

B. Projected Water Demands

1. If applicable, attach or cite projected water supply demands from the applicable Regional Water Planning Group for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirements from such growth.

III. WATER SUPPLY SYSTEM DATA

A. Water Supply Sources

1. List all current water supply sources and the amounts authorized (in acre feet) with each.

Water Type	*Source*	*Amount Authorized*
Surface Water		

Groundwater	________	________
Other	________	________

B. Treatment and Distribution System (if providing treated water)

1. Design daily capacity of system (MGD):

2. Storage capacity (MGD):

   a. Elevated

   b. Ground

3. If surface water, do you recycle filter backwash to the head of the plant?

   ☐ Yes ☐ No If yes, approximate amount (MGD):

IV. WASTEWATER SYSTEM DATA

A. Wastewater System Data (if applicable)

1. Design capacity of wastewater treatment plant(s) (MGD):

2. Treated effluent is used for ☐ on-site irrigation, ☐ off-site irrigation, for ☐ plant wash-down, and/or for ☐ chlorination/dechlorination.

   If yes, approximate amount (in gallons per month):

3. Briefly describe the wastewater system(s) of the area serviced by the water utility. Describe how treated wastewater is disposed. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and the receiving stream if wastewater is discharged.

B. Wastewater Data for Service Area (if applicable)

1. Percent of water service area served by wastewater system: %

2. Monthly volume treated for previous five years (in 1,000 gallons):

Year					
Month					
January					
February					
March					
April					

May					
June					
July					
August					
September					
October					
November					
December					
Totals					

Water Conservation Plan

In addition to the utility profile, please attach the following as required by Title 30, Texas Administrative Code, §288.2. Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.

A. *Record Management System*

The water conservation plan must include a record management system which allows for the classification of water sales and uses in to the most detailed level of water use data currently available to it, including if possible, the following sectors: residential (single and multi-family), commercial.

B. *Specific, Quantified 5 & 10–Year Targets*

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use in gallons per capita per day. Note that the goals established by a public water supplier under this subparagraph are not enforceable. These goals must be updated during the five-year review and submittal.

C. *Measuring and Accounting for Diversions*

The water conservation plan must include a statement about the water suppliers metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply.

D. *Universal Metering*

The water conservation plan must include and a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

E. *Measures to Determine and Control Water Loss*

The water conservation plan must include measures to determine and control water loss (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections; abandoned services; etc.).

F. *Continuing Public Education & Information*

The water conservation plan must include a description of the program of continuing public education and information regarding water conservation by the water supplier.

G. *Non–Promotional Water Rate Structure*

The water supplier must have a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. This rate structure must be listed in the water conservation plan.

H. *Reservoir Systems Operations Plan*

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

I. Enforcement Procedure and Plan Adoption

The water conservation plan must include a means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan.

J. Coordination with the Regional Water Planning Group(s)

The water conservation plan must include documentation of coordination with the regional water planning groups for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

K. Plan Review and Update

A public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

VI. ADDITIONAL REQUIREMENTS FOR LARGE SUPPLIERS

Required of suppliers serving population of 5,000 or more or a projected population of 5,000 or more within the next ten years:

A. Leak Detection and Repair

The plan must include a description of the program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted for uses of water.

B. Contract Requirements

A requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of this chapter.

VII. ADDITIONAL CONSERVATION STRATEGIES

Any combination of the following strategies shall be selected by the water supplier, in addition to the minimum requirements of 30 TAC §288.2(1), if they are necessary in order to achieve the stated water conservation goals of the plan. The commission may require by commission order that any of the following strategies be implemented by the water supplier if the commission determines that the strategies are necessary in order for the conservation plan to be achieved:

1. Conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates;

2. Adoption of ordinances, plumbing codes, and/or rules requiring water conserving plumbing fixtures to be installed in new structures and existing structures undergoing substantial modification or addition;

3. A program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures;

4. A program for reuse and/or recycling of wastewater and/or graywater;

5. A program for pressure control and/or reduction in the distribution system and/or for customer connections;

6. A program and/or ordinance(s) for landscape water management;

7. A method for monitoring the effectiveness and efficiency of the water conservation plan; and

8. Any other water conservation practice, method, or technique which the water supplier shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

VIII. WATER CONSERVATION PLANS SUBMITTED WITH A WATER RIGHT APPLICATION FOR NEW OR ADDITIONAL STATE WATER

Water Conservation Plans submitted with a water right application for New or Additional State Water must include data and information which:

1. support the applicant's proposed use of water with consideration of the water conservation goals of the water conservation plan;

2. evaluates conservation as an alternative to the proposed appropriation; and

3. evaluates any other feasible alternative to new water development including, but not limited to, waste prevention, recycling and reuse, water transfer and marketing, regionalization, and optimum water management practices and procedures.

Additionally, it shall be the burden of proof of the applicant to demonstrate that no feasible alternative to the proposed appropriation exists and that the requested amount of appropriation is necessary and reasonable for the proposed use.

Texas Commission on Environmental Quality
Water Availability Division
MC-160, P.O. Box 13087 Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-2214

Utility Profile and Water Conservation Plan Requirements for Wholesale Public Water Suppliers

This form is provided to assist wholesale public water suppliers in water conservation plan development. If you need assistance in completing this form or in developing your plan, please contact the Conservation staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Water users can find best management practices (BMPs) at the Texas Water Development Board's website http://www.twdb.texas.gov/conservation/BMPs/index.asp. The practices are broken out into sectors such as Agriculture, Commercial and Institutional, Industrial, Municipal and Wholesale. BMPs are voluntary measures that water users use to develop the required components of Title 30, Texas Administrative Code, Chapter 288. BMPs can also be implemented in addition to the rule requirements to achieve water conservation goals.

Contact Information

Name: Click to add text

Address: ____________________

Telephone Number: ( ) ________ Fax: ( ) ________

Water Right No.(s): ____________________

Regional Water Planning Group: ____________________

Person responsible for implementing conservation program: ________ Phone: ( ) ________

Form Completed By: ____________________

Title: ____________________

Signature: ________ Date: / /

A water conservation plan for wholesale public water suppliers must include the following requirements (as detailed in 30 TAC Section 288.5). If the plan does not provide information for each requirement, you must include in the plan an explanation of why the requirement is not applicable.

Utility Profile

I. WHOLESALE SERVICE AREA POPULATION AND CUSTOMER DATA

A. Population and Service Area Data:

1. Service area size (in square miles):

   (Please attach a copy of service-area map)

2. Current population of service area:

3. Current population served for:

   a. Water

   b. Wastewater

4. Population served for previous five years:

Year	*Population*

5. Projected population for service area in the following decades:

Year	*Population*
2020	
2030	
2040	
2050	
2060	

6. List source or method for the calculation of current and projected population size.

B. Customer Data

List (or attach) the names of all wholesale customers, amount of annual contract, and amount of annual use for each customer for the previous year:

Wholesale Customer	*Contracted Amount (Acre-feet)*	*Previous Year Amount of Water Delivered (acre-feet)*

II. WATER USE DATA FOR SERVICE AREA

A. *Water Delivery*

Indicate if the water provided under wholesale contracts is treated or raw water and the annual amounts for the previous five years (in acre feet):

Year	*Treated Water*	*Raw Water*
Totals		

B. *Water Accounting Data*

1. Total amount of water diverted at the point of diversion(s) for the previous five years (in acre-feet) for all water uses:

Year					
Month					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					

Totals | ___ | ___ | ___ | ___ | ___

2. Wholesale population served and total amount of water diverted for **municipal use** for the previous five years (in acre-feet):

Year	*Total Population Served*	*Total Annual Water Diverted for Municipal Use*

C. Projected Water Demands

If applicable, project and attach water supply demands for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirements from such growth.

III. WATER SUPPLY SYSTEM DATA

A. Projected Water Demands

List all current water supply sources and the amounts authorized (in acre feet) with each.

Water Type	*Source*	*Amount Authorized*
Surface Water		
Groundwater		
Other		

B. Treatment and Distribution System (if providing treated water)

1. Design daily capacity of system (MGD):

2. Storage capacity (MGD):
   a. Elevated
   b. Ground

3. Please attach a description of the water system. Include the number of treatment plants, wells, and storage tanks

IV. WASTEWATER SYSTEM DATA

A. Wastewater System Data (if applicable)

1. Design capacity of wastewater treatment plant(s) (MGD):

2. Briefly describe the wastewater system(s) of the area serviced by the wholesale public water supplier. Describe how treated wastewater is disposed. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and the receiving stream if wastewater is discharged.

B. Wastewater Data for Service Area (if applicable)

1. Percent of water service area served by wastewater system: %

2. Monthly volume treated for previous five years (in 1,000 gallons):

Year					
Month					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Totals					

Water Conservation Plan

In addition to the description of the wholesaler’s service area (profile from above), a water conservation plan for a wholesale public water supplier must include, at a minimum, additional information as required by Title 30, Texas Administrative Code, Chapter 288.5. Note: If the water conservation plan does not provide information for each requirement an explanation must be included as to why the requirement is not applicable.

A. *Specific, Quantified 5 & 10–Year Targets*

The water conservation plan must include specific, quantified 5-year and 10-year targets for water savings including, where appropriate, target goals for municipal use in gallons per capita per day for the wholesaler's service area, maximum acceptable water loss, and the basis for the development of these goals. Note that the goals established by a wholesale water supplier under this subparagraph are not enforceable. These goals must be updated during the 5-year review and submittal.

B. *Measuring and Accounting for Diversions*

The water conservation plan must include a description as to which practice(s) and/or device(s) will be utilized to measure and account for the amount of water diverted from the source(s) of supply.

C. *Record Management Program*

The water conservation plan must include a monitoring and record management program for determining water deliveries, sales, and losses.

D. *Metering/Leak–Detection and Repair Program*

The water conservation plan must include a program of metering and leak detection and repair for the wholesaler’s water storage, delivery, and distribution system.

E. *Contract Requirements for Successive Customer Conservation*

The water conservation plan must include a requirement in every water supply contract entered into or renewed after official adoption of the water conservation plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements of Title 30 TAC Chapter 288. If the customer intends to resell the water, then the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of this chapter.

F. *Reservoir Systems Operations Plan*

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin. The reservoir systems operations plan shall include optimization of water supplies as one of the significant goals of the plan.

G. *Enforcement Procedure and Official Adoption*

The water conservation plan must include a means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan.

H. *Coordination with the Regional Water Planning Group(s)*

The water conservation plan must include documentation of coordination with the regional water planning groups for the service area of the wholesale water supplier in order to ensure consistency with the appropriate approved regional water plans.

Example statement to be included within the water conservation plan:

The service area of the ____________ (name of water supplier) is located within the __________ (name of regional water planning area or areas) and __________ (name of water supplier) has provided a copy of this water conservation plan to the ___________ (name of regional water planning group or groups).

I. *Plan Review and Update*

A wholesale water supplier shall review and update its water conservation plan, as appropriate based on an assessment of previous 5-year and 10-year targets and any other new or updated information. A wholesale water supplier shall review and update the next revision of its water conservation plan no later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

V. ADDITIONAL CONSERVATION STRATEGIES

Any combination of the following strategies shall be selected by the water wholesaler, in addition to the minimum requirements of 30 TAC §288.5(1), if they are necessary in order to achieve the stated water conservation goals of the plan. The commission may require by commission order that any of the following strategies be implemented by the water supplier if the commission determines that the strategies are necessary in order for the conservation plan to be achieved:

1. Conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates;

2. A program to assist agricultural customers in the development of conservation, pollution prevention and abatement plans;

3. A program for reuse and/or recycling of wastewater and/or graywater;

4. Any other water conservation practice, method, or technique which the wholesaler shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

VI. WATER CONSERVATION PLANS SUBMITTED WITH A WATER RIGHT APPLICATION FOR NEW OR ADDITIONAL STATE WATER

Water Conservation Plans submitted with a water right application for New or Additional State Water must include data and information which:

1. support the applicant’s proposed use of water with consideration of the water conservation goals of the water conservation plan;

2. evaluates conservation as an alternative to the proposed appropriation; and

3. evaluates any other feasible alternative to new water development including, but not limited to, waste prevention, recycling and reuse, water transfer and marketing, regionalization, and optimum water management practices and procedures.

Additionally, it shall be the burden of proof of the applicant to demonstrate that no feasible alternative to the proposed appropriation exists and that the requested amount of appropriation is necessary and reasonable for the proposed use.

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Model Drought Contingency Plans

For municipal water users, wholesale public water suppliers, and irrigation districts the CBRWPG compiled a summary of common drought contingency measures identified in existing drought contingency plans for water user groups in the Coastal Bend Region. The CBRWPG recommends appending this region specific table, beginning on the next page, with the TCEQ model drought contingency plan for retail public water suppliers (also attached). The TCEQ form can be accessed electronically on the TCEQ website, along with a handbook for drought contingency planning or a customized drought contingency plan form for water supply corporations, at: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/contingency.html

Municipal water users, wholesale water providers, and irrigation districts in the area seeking to develop a drought contingency plan are encouraged to consider the attached information from the CPRWPG as a guide for utilities comparable in size and with similar water source (included in summary table). However, a one-size-fits-all approach is often impractical for all municipal water utilities and accordingly. It is to the discretion of the utility to develop a drought contingency plan that serves its utility best. Current links to TCEQ model drought contingency forms based on entity type are listed below.

Municipal Water Users (see attached Retail Public Water Supplier form)

https://www.tceq.texas.gov/assets/public/permitting/watersupply/drought/20191.pdf

Wholesale Public Water Providers (see attached Wholesale Public Water Supplier form)

https://www.tceq.texas.gov/assets/public/permitting/watersupply/drought/20193.pdf

Irrigation Districts (see attached Irrigation District Supplier form)

https://www.tceq.texas.gov/assets/public/permitting/watersupply/drought/dcpirr.pdf

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				Drought Contingency Measures											Water Supplies	
Wholesale Water Provider/Water User Group	**Census 2010 (For Water User Groups Only)**	**DCP Available**	**Date**	**Watering schedules/ Landscape irrigation restrictions**	**Water demand reduction targets**	**Potable water use restrictions**	**Vehicle washing restrictions**	**Restrictions on wash down of hard-surfaces, buildings, and/or structures**	**Restrictions on new service connections, pipeline extensions, etc.**	**Restrictions on serving water to patrons at restaurants**	**Restrictions on flushing gutters, controllable leaks, and/or permitting water to run or accumulate**	**Restrictions on the use of water for pools, ponds, or fountains**	**Restrictions on use of water for dust control**	**Others**	**SW**	**GW**
Wholesale Water Providers																
City of Corpus Christi		Y	2018	√	√	√	√	√	√			√		√	√	
SPMWD		Y	2019	√	√	√	√	√				√	√	√	√	
South Texas Water Authority		Y	2018	√	√									√	√	
Nueces County WCID #3		Y	2019	√	√	√	√	√				√			√	
LNRA		Y	2014		√									√	√	
Water User Groups																
Aransas Pass	8,204	Y	2008	√	√		√	√	√	√	√	√	√	√	√	√
Rockport	8,766	Y	2013	√	√		√	√			√	√	√	√	√	
Baffin Bay WSC	N/A	Y	2015	√	√		√	√			√	√				√
Beeville	12,863	Y	2020	√	√	√	√	√	√			√	√	√	√	
City of Three Rivers	1,848	Y	2014	√	√		√	√			√	√	√		√	√
San Diego MUD #1	4,488	Y	2000	√	√		√	√			√	√	√	√		√
Alice	19,104	Y	2019	√	√		√	√	√	√	√	√	√	√	√	
Orange Grove	1,318	Y	2000	√	√		√	√	√	√	√	√	√	√		√
Kingsville	26,213	Y	2002	√	√		√	√	√	√	√	√	√	√	√	√
Ricardo WSC	2,631	Y	2018	√	√	√	√	√	√	√	√	√	√	√	√	
El Oso WSC	1,019	Y	2009	√	√		√	√	√	√	√	√	√	√		√
McCoy WSC	169	Y	2000	√	√		√	√	√	√	√	√	√	√		√
Nueces WSC	2,322	Y	2019	√	√	√	√	√	√	√	√	√	√	√	√	
River Acres WSC	2,421	Y	2000	√	√	√	√	√	√	√	√	√	√	√	√	
Odem	2,389	Y	2013	√	√	√	√	√	√	√	√	√		√	√	
Ingleside	9,387	Y	2018	√	√	√	√	√	√	√	√	√	√	√	√	√
Taft	3,048	Y	2013	√	√		√	√	√	√	√	√	√	√	√	
Portland	15,099	Y	2013	√	√	√	√	√	√	√	√	√	√	√	√	
Rincon WSC	3,243	Y	2009	√	√		√				√	√		√	√	
County-Other Entities																
Aransas County MUD #1		Y	2009	√							√			√		√
Blueberry Hills		Y	2005	√	√		√	√			√	√	√	√		√
Copano Heights Water Company		Y	2018	√	√		√	√			√	√	√		√	
Escondido Creek Estates		Y	2000	√			√			√	√	√	√	√		√
Freer WCID		Y	2000	√	√		√	√	√	√	√	√	√	√		√
Riviera		Y	2000	√			√	√			√	√	√	√		√
Baffin Bay WSC			2015	√	√											√
Pettus MUD		Y	2000	√			√	√			√	√		√		√

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Texas Commission on Environmental Quality
Water Availability Division
MC-160, P.O. Box 13087 Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-2214

Drought Contingency Plan
for a Retail Public Water Supplier

This form is provided as a model of a drought contingency plan for a retail public water supplier. If you need assistance in completing this form or in developing your plan, please contact the Conservation Staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Drought Contingency Plans must be formally adopted by the governing body of the water provider and documentation of adoption must be submitted with the plan. For municipal water systems, adoption would be by the city council as an ordinance. For other types of publicly-owned water systems (example: utility districts), plan adoption would be by resolution of the entity's board of directors adopting the plan as administrative rules. For private investor-owned utilities, the drought contingency plan is to be incorporated into the utility's rate tariff. Each water supplier shall provide documentation of the formal adoption of their drought contingency plan.

Name:		
Address:		
Telephone Number:	( )	Fax: ( )
Water Right No.(s):		
Regional Water Planning Group:		
Form Completed by:		
Title:		
Person responsible for implementation:		Phone: ( )
Signature:		Date: / /

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ________________________ (*name of your water supplier*) hereby adopts the following regulations and restrictions on the delivery and consumption of water.

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section X of this Plan.

Section II: Public Involvement
Opportunity for the public to provide input into the preparation of the Plan was provided by the _________________________ (*name of your water supplier*) by means of ___________________ _____________________________ (*describe methods used to inform the public about the preparation of the plan and provide opportunities for input; for example, scheduling and providing public notice of a public meeting to accept input on the Plan*).

Section III: Public Education
The _________________________ (*name of your water supplier*) will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of ____ (*describe methods to be used to provide information to the public about the Plan; for example, public events, press releases or utility bill inserts*).

Section IV: Coordination with Regional Water Planning Groups
The service area of the _________________________ (*name of your water supplier*) is located within the _________________________ (*name of regional water planning area or areas*) and _________________________ (*name of your water supplier*) has provided a copy of this Plan to the _________________________ (*name of your regional water planning group or groups*).

Section V: Authorization
The _________________________ (*designated official; for example, the mayor, city manager, utility director, general manager, etc.*), or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _________________________ (*designated official*) or his/her designee shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application
The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the _________________________ (*name of your water supplier*). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions
For the purposes of this Plan**,** the following definitions shall apply:

<u>Aesthetic water use</u>: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

<u>Commercial and institutional water use</u>: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

<u>Conservation</u>: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

<u>Customer</u>: any person, company, or organization using water supplied by _________________________ (*name of your water supplier*).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The _________________________ (*designated official*) or his/her designee shall monitor water supply and/or demand conditions on a _________________________ (*example: daily, weekly, monthly*) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering criteria described below are based on: ____.
(*Provide a brief description of the rationale for the triggering criteria; for example, triggering criteria / trigger levels based on a statistical analysis of the vulnerability of the water source under drought of record conditions, or based on known system capacity limits*).

Utilization of alternative water sources and/or alternative delivery mechanisms:

Alternative water source(s) for _________________________ (*name of utility*) is/are: ____.

(Examples: Other well(s), Inter-connection with other system, Temporary use of a non-municipal water supply, Purchased water, Use of reclaimed water for non-potable purposes, etc.).

Stage 1 Triggers -- MILD Water Shortage Conditions

Requirements for initiation

Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII Definitions, when ____.
(*Describe triggering criteria / trigger levels; see examples below*).

Following are examples of the types of triggering criteria that might be used in one or more successive stages of a drought contingency plan. The public water supplier may devise other triggering criteria and an appropriate number of stages tailored to its system. One or a combination of the criteria selected by the public water supplier must be defined for each drought response stage, but usually not all will apply.

Example 1: *Annually, beginning on May 1 through September 30.*

Example 2: *When the water supply available to the __________________________ (name of your water supplier) is equal to or less than ____________ (acre-feet, percentage of storage, etc.).*

Example 3: *When, pursuant to requirements specified in the __________________________ (name of* ***your*** *water supplier) wholesale water purchase contract with __________________________ (name of your wholesale water supplier), notification is received requesting initiation of Stage 1 of the Drought Contingency Plan.*

Example 4: *When flows in the __________________________ (name of stream or river) are equal to or less than _____________ cubic feet per second.*

Example 5: *When the static water level in the __________________________ (name of your water supplier) well(s) is equal to or less than ___________ feet above/below mean sea level.*

Example 6: *When the specific capacity of the __________________________ (name of your water supplier) well(s) is equal to or less than ________ percent of the well's original specific capacity.*

Example 7: *When total daily water demand equals or exceeds ___________ million gallons for _____________ consecutive days of ________________ million gallons on a single day (example: based on the safe operating capacity of water supply facilities).*

Example 8: *Continually falling treated water reservoir levels which do not refill above _________ percent overnight (example: based on an evaluation of minimum treated water storage required to avoid system outage).*

Requirements for termination

Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of _____________ (*example: 3*) consecutive days.

Stage 2 Triggers – MODERATE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when ____ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of __________ (*example: 3*) consecutive days. Upon termination of Stage 2, Stage 1, or the applicable drought response stage based on the triggering criteria, becomes operative.

Stage 3 Triggers – SEVERE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when ______________________________________ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of __________ (*example: 3*) consecutive days. Upon termination of Stage 3, Stage 2, or the applicable drought response stage based on the triggering criteria, becomes operative.

Stage 4 Triggers – CRITICAL Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when ____ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of __________ (*example: 3*) consecutive days. Upon termination of Stage 4, Stage 3, or the applicable drought response stage based on the triggering criteria, becomes operative.

Stage 5 Triggers – EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when _________________________ (*designated official*), or his/her designee, determines that a water supply emergency exists based on:

1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; **or**

2. Natural or man-made contamination of the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of __________ (*example: 3*) consecutive days.

Stage 6 Triggers – WATER ALLOCATION

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 5 of this Plan when ____ (*describe triggering criteria, see examples in Stage 1*).

Requirements for termination - Water allocation may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of _________ (*example: 3*) consecutive days.

Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (example: supply source contamination and system capacity limitations).

Section IX: Drought Response Stages
The ________________________ (*designated official*), or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency or water shortage condition exists and shall implement the following notification procedures:

Notification
Notification of the Public:
The ________________________ (*designated official*) or his/ her designee shall notify the public by means of:

Examples:
publication in a newspaper of general circulation,
direct mail to each customer,
public service announcements,
signs posted in public places
take-home fliers at schools.

Additional Notification:
The ________________________ (*designated official*) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

Examples:
Mayor / Chairman and members of the City Council / Utility Board
Fire Chief(s)
City and/or County Emergency Management Coordinator(s)
County Judge & Commissioner(s)
State Disaster District / Department of Public Safety
TCEQ *(required when* mandatory *restrictions are imposed)*
Major water users
Critical water users, i.e. hospitals
Parks / street superintendents & public facilities managers

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Stage 1 Response – MILD Water Shortage Conditions

Target: Achieve a voluntary __________ percent reduction in __________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

D*escribe additional measures, if any, to be implemented directly by (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: system water loss control, activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes.*

Voluntary Water Use Restrictions for Reducing Demand:

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of midnight and 10:00 a.m. and 8:00 p.m. to midnight on designated watering days.

(b) All operations of the _________________________ (*name of your water supplier*) shall adhere to water use restrictions prescribed for Stage 1 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response – MODERATE Water Shortage Conditions

Target: Achieve a __________ percent reduction in _________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _________________________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: system water loss control, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rises. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to fire fighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the __________________________ (*name of your water supplier*).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight. However, if the golf course utilizes a water source other than that provided by the _________________________ (*name of your water supplier*), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. use of water for dust control;
4. flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response – SEVERE Water Shortage Conditions

<u>Target</u>: Achieve a __________ percent reduction in __________________________ (*example: total water use, daily water demand, etc.*).

<u>Best Management Practices for Supply Management</u>:

Describe additional measures, if any, to be implemented directly by _________________________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: system water loss control, *reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.*

Water Use Restrictions for Demand Reduction:
All requirements of Stage 2 shall remain in effect during Stage 3 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the _________________________ (*name of your water supplier*).

(c) The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

Stage 4 Response – CRITICAL Water Shortage Conditions

Target: Achieve a __________ percent reduction in _________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _________________________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: system water loss control, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:
All requirements of Stage 2 and 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10 p.m.

(c) The filling, refilling, or adding of water to swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response – EMERGENCY Water Shortage Conditions

Target: Achieve a __________ percent reduction in _________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _________________________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: system water loss control, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:
All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

Stage 6 Response – WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare, the _________________________ (*designated official*) is hereby authorized to allocate water according to the following water allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

"Household" means the residential premises served by the customer's meter. "Persons per household" include only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of two (2) persons unless the customer notifies the _________________________ (*name of your water supplier*) of a greater number of persons per household on a form prescribed by the _________________________ (*designated official*). The _________________________ (*designated official*) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the _________________________ (*name of your water supplier*) offices to complete and sign the form claiming more than two (2) persons per household. New customers may claim more persons per household at the time of applying for water service on the form prescribed by the _________________________ (*designated official*). When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the _________________________ (*name of water supplier*) on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the _________________________ (*name of your water supplier*) in writing within two (2) days. In prescribing the method for claiming more than two (2) persons per household, the _________________________ (*designated official*) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the _________________________ (*name of your water supplier*) of a reduction in the number of person in a household shall be fined not less than $__________.

Residential water customers shall pay the following surcharges:

$__________ for the first 1,000 gallons over allocation.
$__________ for the second 1,000 gallons over allocation.
$__________ for the third 1,000 gallons over allocation.
$__________ for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (example: apartments, mobile homes) shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the _________________________ (*name of your water supplier*) of a greater number on a form prescribed by the _________________________ (*designated official*). The _________________________ (*designated official*) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the _________________________ (*name of your water supplier*) offices to complete and sign the form claiming more than two (2) dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not. New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the _________________________ (*designated official*). If the number of dwelling units served by a master meter is reduced, the customer shall notify the _________________________ (*name of your water supplier*) in writing within two (2) days. In prescribing the method for claiming more than two (2) dwelling units, the _________________________ (*designated official*) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the _________________________ (*name of your water supplier*) of a reduction in the number of person in a household shall be fined not less than $__________. Customers billed from a master meter under this provision shall pay the following monthly surcharges:

$__________ for 1,000 gallons over allocation up through 1,000 gallons for each dwelling unit.
$__________, thereafter, for each additional 1,000 gallons over allocation up through a second 1,000 gallons for each dwelling unit.
$__________, thereafter, for each additional 1,000 gallons over allocation up through a third 1,000 gallons for each dwelling unit.
$__________, thereafter for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the _________________________ (*designated official*), or his/her designee, for each nonresidential commercial customer other than an industrial customer who uses water for processing purposes. The non-residential customer's allocation shall be approximately __________ (*example: 75%*) percent of the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. Provided, however, a customer, __________percent of whose monthly usage is less than __________ gallons, shall be allocated __________ gallons. The _________________________ (*designated official*) shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the _________________________ (*name of your water supplier*) to determine the allocation. Upon request of the customer or at the initiative of the _________________________ (*designated official*), the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage, (2) one nonresidential customer agrees to transfer part of its allocation to another nonresidential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the _________________________ (*designated official or alternatively, a special water allocation review committee*). Nonresidential commercial customers shall pay the following surcharges:

Customers whose allocation is __________ gallons through __________ gallons per month:

$__________ per thousand gallons for the first 1,000 gallons over allocation.
$__________ per thousand gallons for the second 1,000 gallons over allocation.
$__________ per thousand gallons for the third 1,000 gallons over allocation.
$__________ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is __________ gallons per month or more:

__________times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
__________times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
__________times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
__________times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Industrial Customers

A monthly water allocation shall be established by the _________________________ (*designated official*), or his/her designee, for each industrial customer, which uses water for processing purposes. The industrial customer's allocation shall be approximately __________ (*example: 90%*) percent of the customer's water usage baseline. Ninety (90) days after the initial imposition of the allocation for industrial customers, the industrial customer's allocation shall be further reduced to __________ (*example: 85%*) percent of the customer's water usage baseline. The industrial customer's water use baseline will be computed on the average water use for the __________ month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than __________ months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The _________________________ (*designated official*) shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the _________________________ (*name of your water supplier*) to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of receipt of written notice. Upon request of the customer or at the initiative of the _________________________ (*designated official*), the allocation may be reduced or increased, (1) if the designated period does not accurately reflect the customer's normal water use because the customer had shutdown a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shutdown or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the _________________________ (*designated official or alternatively, a special water allocation review committee*). Industrial customers shall pay the following surcharges:

Customers whose allocation is __________ gallons through __________ gallons per month:

$__________ per thousand gallons for the first 1,000 gallons over allocation.
$__________ per thousand gallons for the second 1,000 gallons over allocation.
$__________ per thousand gallons for the third 1,000 gallons over allocation.
$__________ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is __________ gallons per month or more:

__________times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
__________times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
__________times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
__________times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the _________________________ (*name of your water supplier*) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by _________________________ (*designated official*), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction shall be punished by a fine of not less than __________ dollars ($__________) and not more than __________ dollars ($__________). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the _________________________ (*designated official*) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $__________, and any other costs incurred by the _________________________ (*name of your water supplier*) in discontinuing service. In addition, suitable assurance must be given to the _________________________ (*designated official*) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the _________________________ (*name of your water supplier*), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that a violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any employee of the _________________________ (*name of your water supplier*), police officer, or other _________________________ employee designated by the _________________________ (*designated official*), may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the _________________________ (*example: municipal court*) on the date shown on the citation for which the date shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in _________________________ (*example: municipal court*) to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in _________________________ (*example: municipal court*), a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in _________________________ (*example: municipal court*) before all other cases.

Section XI: Variances

The _________________________ (*designated official*), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the _________________________ (*name of your water supplier*) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the _________________________ (*designated official*), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

Texas Commission on Environmental Quality
Water Availability Division
MC-160, P.O. Box 13087 Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-2214

Drought Contingency Plan
for a Wholesale Public Water Supplier

This form is provided as a model of a drought contingency plan for a wholesale public water supplier. If you need assistance in completing this form or in developing your plan, please contact the Conservation Staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Drought Contingency Plans must be formally adopted by the governing body of the water provider and documentation of adoption must be submitted with the plan. For example, adoption by a city council as an ordinance or by resolution of the entity's board of directors adopting the plan as administrative rules.

Name:	______________________________
Address:	______________________________
Telephone Number:	( ) Fax: ( )
Water Right No.(s):	______________________________
Regional Water Planning Group:	______________________________
Form Completed by:	______________________________
Title:	______________________________
Person responsible for implementation:	Phone: ( )
Signature:	Date: / /

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and/or to protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ________________________ (*name of your water supplier*) adopts the following Drought Contingency Plan (the Plan).

Section II: Public Involvement

Opportunity for the public and wholesale water customers to provide input into the preparation of the Plan was provided by ________________________ (*name of your water supplier*) by means of ____ (*describe methods used to inform the public and wholesale customers about the preparation of the plan and opportunities for input; for example, scheduling and proving public notice of a public meeting to accept input on the Plan*).

Section III: Wholesale Water Customer Education

The _________________________ (*name of your water supplier*) will periodically provide wholesale water customers with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of ____ (*example: describe methods to be used to provide customers with information about the Plan; for example, providing a copy of the Plan or periodically including information about the Plan with invoices for water sales*).

Section IV: Coordination with Regional Water Planning Groups

The water service area of the _________________________ (name of your water supplier) is located within the _________________________ (*name of regional water planning area or areas*) and the _________________________ (*name of your water supplier*) has provided a copy of the Plan to the _________________________ (*name of your regional water planning group or groups*).

Section V: Authorization

The _________________________ (*designated official; for example, the general manager or executive director*), or his/her designee, is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _________________________ or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all customers utilizing water provided by the _________________________ (*name of your water supplier*). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Criteria for Initiation and Termination of Drought Response Stages

The _________________________ (*designated official*), or his/her designee, shall monitor water supply and/or demand conditions on a (*example: weekly, monthly*) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan. Customer notification of the initiation or termination of drought response stages will be made by mail or telephone. The news media will also be informed.

The triggering criteria described below are based on:
____.
(*provide a brief description of the rationale for the triggering criteria; for example, triggering criteria are based on a statistical analysis of the vulnerability of the water source under drought of record conditions).*

Utilization of alternative water sources and/or alternative delivery mechanisms:

Alternative water source(s) for _________________________ (*name of utility*) is/are: ____.
(Examples: Other well(s), Inter-connection with other system, Temporary use of a non-municipal water supply, Purchased water, Use of reclaimed water for non-potable purposes, etc.).

Stage 1 Triggers -- MILD Water Shortage Conditions

Requirements for initiation – The _________________________ (*name of your water supplier*) will recognize that a mild water shortage condition exists when ____ (*describe triggering criteria, see examples below).*

> ***Below are examples of the types of triggering criteria that might be used in a wholesale water supplier's drought contingency plan.*** *The wholesale water supplier may devise other triggering criteria and an appropriate number of stages tailored to its system; however, the plan must contain a minimum of three drought stages.* ***One or a combination of such criteria may be defined for each drought response stage:***
>
> > ***Example 1: Water in storage in the _________________________ (name of reservoir) is equal to or less than _______________ (acre-feet and/or percentage of storage capacity).***
> >
> > ***Example 2: When the combined storage in the _________________________ (name of reservoirs) is equal to or less than _______________ (acre-feet and/or percentage of storage capacity).***
> >
> > ***Example 3: Flows as measured by the U.S. Geological Survey gage on the _________________________ (name of river) near _________________________, Texas reaches _______________ cubic feet per second (cfs).***
> >
> > ***Example 4: When total daily water demand equals or exceeds _______________ million gallons for _______________ consecutive days or _______________ million gallons on a single day.***
> >
> > ***Example 5: When total daily water demand equals or exceeds _______________ percent of the safe operating capacity of _______________ million gallons per day for _______________ consecutive days or _______________ percent on a single day.***

Requirements for termination - Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of _______________ (*example: 30*) consecutive days. The _________________________ (*name of water supplier*) will notify its wholesale customers and the media of the termination of Stage 1.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

Requirements for initiation – The _________________________ (*name of your water supplier*) will recognize that a moderate water shortage condition exists when ____ (*describe triggering criteria*).

Requirements for termination - Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of _______________ (*example: 30*) consecutive days. Upon termination of Stage 2, Stage 1, or the applicable drought response stage based on the triggering criteria, becomes operative. The _________________________ (*name of your water supplier*) will notify its wholesale customers and the media of the termination of Stage 2.

Stage 3 Triggers -- SEVERE Water Shortage Conditions

Requirements for initiation – The _________________________ (*name of your water supplier*) will recognize that a severe water shortage condition exists when ____ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination - Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of __________ (*example: 30*) consecutive days. Upon termination of Stage 3, Stage 2, or the applicable drought response stage based on the triggering criteria, becomes operative. The _________________________ (*name of your water supplier*) will notify its wholesale customers and the media of the termination of Stage 3.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for initiation - The _________________________ (*name of your water supplier*) will recognize that an emergency water shortage condition exists when ____ (*describe triggering criteria*; *see examples below*).

Example 1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or

Example 2. Natural or man-made contamination of the water supply source(s).

Requirements for termination - Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of _______________ (*example: 30*) consecutive days. The _________________________ (*name of your water supplier*) will notify its wholesale customers and the media of the termination of Stage 4.

Section VIII: Drought Response Stages

The _________________________ (*designated official*), or his/her designee, shall monitor water supply and/or demand conditions and, in accordance with the triggering criteria set forth in Section VII, shall determine that mild, moderate, severe, or critical water shortage conditions exist or that an emergency condition exists and shall implement the following actions:

Stage 1 Response -- MILD Water Shortage Conditions

Target: Achieve a voluntary _______________ percent reduction in _________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _________________________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for nonpotable purposes.

Water Use Restrictions for Reducing Demand:

(a) The _________________________ (*designated official*), or his/her designee(s), will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate voluntary measures to reduce water use (*example: implement Stage 1 or appropriate stage of the customer's drought contingency plan*).

(b) The _________________________ (*designated official*), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 2 Response -- MODERATE Water Shortage Conditions

Target: Achieve a _______________ percent reduction in _________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ________________________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

(a) The ________________________ (*designated official*), or his/her designee(s), will request wholesale water customers to initiate mandatory measures to reduce non-essential water use (*example: implement Stage 2 or appropriate stage of the customer's drought contingency plan*).

(b) The ________________________ (*designated official*), or his/her designee(s), will initiate weekly contact with wholesale water customers to discuss water supply and/or demand conditions and the possibility of pro rata curtailment of water diversions and/or deliveries.

(c) The ________________________ (*designated official*), or his/her designee(s), will further prepare for the implementation of pro rata curtailment of water diversions and/or deliveries by preparing a monthly water usage allocation baseline for each wholesale customer.

(d) The ________________________ (*designated official*), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 3 Response -- SEVERE Water Shortage Conditions

Target: Achieve a _____________ percent reduction in ________________________ (*example: total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ________________________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

(a) The ________________________ (*designated official*), or his/her designee(s), will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate additional mandatory measures to reduce non-essential water use (example: implement Stage 3 or appropriate stage of the customer's drought contingency plan).

(b) The ________________________ (*designated official*), or his/her designee(s), will initiate pro rata curtailment of water diversions and/or deliveries for each wholesale customer.

(c) The ________________________ (*designated official*), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 4 Response -- EMERGENCY Water Shortage Conditions

Whenever emergency water shortage conditions exist as defined in Section VII of the Plan, the _________________________ (*designated official*) shall:

1. Assess the severity of the problem and identify the actions needed and time required to solve the problem.

2. Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems (*example: notification of the public to reduce water use until service is restored*).

3. If appropriate, notify city, county, and/or state emergency response officials for assistance.

4. Undertake necessary actions, including repairs and/or clean-up as needed.

5. Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions.

Section IX: Pro Rata Curtailment

In the event that the triggering criteria specified in Section VII of the Plan for Stage 3 – Severe Water Shortage Conditions have been met, the _________________________ (*designated official*) is hereby authorized to initiate allocation of water supplies on a pro rata basis in accordance with Texas Water Code, §11.039.

Section X: Contract Provisions

The _________________________ (*name of your water supplier*) will include a provision in every wholesale water contract entered into or renewed after adoption of the plan, including contract extensions, that in case of a shortage of water resulting from drought, the water to be distributed shall be divided in accordance with Texas Water Code, §11.039.

Section XI: Enforcement

<u>Example of surcharge:</u>
During any period when either mandatory water use restrictions or pro rata allocation of available water supplies are in effect, wholesale customers shall pay the following surcharges on excess water diversions and/or deliveries:

_______ times the normal water charge per acre-foot for water diversions and/or deliveries in excess of the monthly allocation from _______________ percent through _______________ percent above the monthly allocation.

<u>Examples of fines and/or discontinuation of service:</u>
Mandatory water use restrictions or pro rata allocation of available water supplies may be imposed during drought stages and emergency water management actions. These water use restrictions will be enforced by warnings and penalties as follows:

- On the first violation, customers will be notified by written notice that they have violated the mandatory water use restriction.
- If the first violation has not been corrected after ten (10) days from the written notice, _________________________ (*name of your water supplier*) may assess a fine up to $_______________ per violation.
- _________________________ (*name of your water supplier*) may install a flow restricting device in

the line to limit the amount of water which will pass through the meter in a 24-hour period. The utility may charge the customer for the actual cost of installing and removing the flow restricting device, not to exceed fifty dollars ($50.00);

- _________________________ (*name of your water supplier*) maintains the right, at any violation or action level, to disconnect irrigation systems and/or suspend water services to a customer for public safety issues with reconnection fees and possible citations.
- Subsequent violations of the plan shall result in increased fines or upon the occurrence of ______________ violations, after notice, the discontinuation of services. Services discontinued under this provision shall be restored only upon payment of a reconnection fee and any other costs incurred by the utility in discontinuing service.

Section XII: Variances

The _________________________ (*designated official*), or his/her designee, may, in writing, grant a temporary variance to the pro rata water allocation policies provided by this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the public health, welfare, or safety and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Plan shall file a petition for variance with the _________________________ (*designated official*) within 5 days after pro rata allocation has been invoked. All petitions for variances shall be reviewed by the _________________________ (*governing body*), and shall include the following:

(a) Name and address of the petitioner(s).
(b) Detailed statement with supporting data and information as to how the pro rata allocation of water under the policies and procedures established in the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(c) Description of the relief requested.
(d) Period of time for which the variance is sought.
(e) Alternative measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(f) Other pertinent information.

Variances granted by the _________________________ (*governing body*) shall be subject to the following conditions, unless waived or modified by the _________________________ (*governing body*) or its designee:

(a) Variances granted shall include a timetable for compliance.
(b) Variances granted shall expire when the Plan is no longer in effect, unless the petitioner has failed to meet specified requirements.

No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section XIII: Severability

It is hereby declared to be the intention of the _________________________ (*governing body of your water supplier*) that the sections, paragraphs, sentences, clauses, and phrases of this Plan are severable and, if any phrase, clause, sentence, paragraph, or section of this Plan shall be declared unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs, and sections of this Plan, since the same would not have been enacted by the _________________________ (*governing body of your water supplier*) without the incorporation into this Plan of any such unconstitutional phrase, clause, sentence, paragraph, or section.

Texas Commission on Environmental Quality
Water Availability Division
MC-160, P.O. Box 13087 Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-2214

Model Drought Contingency Plan for an Irrigation District

This form is provided as a model of a drought contingency plan for an irrigation district. If you need assistance in completing this form or in developing your plan, please contact the Conservation Staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Drought Contingency Plans must be formally adopted by the governing body of the irrigation district and documentation of adoption must be submitted with the plan. An example resolution can be found at the end of this form.

Irrigation District:	______________________	
Address:	______________________	
Telephone Number:	( )	Fax: ( )
Water Right No.(s):	______________________	
Regional Water Planning Group:	______________________	
Form Completed by:	______________________	
Title:	______________________	
Person responsible for implementation:	______________________	Phone: ( )
Signature:	______________________	Date: / /

Section I: Declaration of Policy, Purpose, and Intent

The Board of Directors of the ________________________ (*name of irrigation district*) deems it to be in the interest of the District to adopt Rules and Regulations governing the equitable and efficient allocation of limited water supplies during times of shortage. These Rules and Regulations constitute the District's drought contingency plan required under Section 11.1272, Texas Water Code, *Vernon's Texas Codes Annotated*, and associated administrative rules of the Texas Commission on Environmental Quality (Title 30, Texas Administrative Code, Chapter 288).

Section II: User Involvement

Opportunity for users of water from the ________________________ (*name of irrigation district*) was provided by means of ____ (*describe methods used to inform water users about the preparation of the plan and opportunities for input; for example, scheduling and providing notice of a public meeting to accept user input on the plan*).

Section III: User Education

The ________________________ (*name of irrigation district*) will periodically provide water users with information about the Plan, including information about the conditions under which water allocation is to be initiated or terminated and the district's policies and procedures for water allocation. This information will be provided by means of _____________________________________ (*example: describe methods to be used to provide water users with information about the Plan; for example, by providing copies of the Plan and by posting water allocation rules and regulations on the district's public bulletin board*).

Section IV: Authorization

The ________________________ (*example: general manager*) is hereby authorized and directed to implement the applicable provision of the Plan upon determination by the Board that such implementation is necessary to ensure the equitable and efficient allocation of limited water supplies during times of shortage.

Section V: Application

The provisions of the Plan shall apply to all persons utilizing water provided by the ________________________ (*name of irrigation district*). The term "person" as used in the Plan includes individuals, corporations, partnerships, associations, and all other legal entities.

Section VI: Initiation of Water Allocation

The ________________________ (*designated official*) shall monitor water supply conditions on a ________________________ (*example: weekly, monthly*) basis and shall make recommendations to the Board regarding irrigation of water allocation. Upon approval of the Board, water allocation will become effective when _____________________________________ (*describe the criteria and the basis for the criteria*):

Below are examples of the types of triggering criteria that might be used; singly or in combination, in an irrigation district's drought contingency plan:

Example 1: Water in storage in the ________________________ (*name of reservoir*) is equal to or less than ______________ (*acre-feet and/or percentage of storage capacity*).

Example 2: Combined storage in the ________________________ (*name or reservoirs*) reservoir system is equal to or less than ______________ (*acre-feet and/or percentage of storage capacity*).

Example 3: Flows as measured by the U.S. Geological Survey gage on the ________________________ (*name of reservoir*) near ________________________, Texas reaches ______________ cubic feet per second (cfs).

Example 4: The storage balance in the district's irrigation water rights account reaches _____________ acre-feet.

Example 5: The storage balance in the district's irrigation water rights account reaches an amount equivalent to _____________ (*number*) irrigations for each flat rate acre in which all flat rate assessments are paid and current.

Example 6: The ________________________ (*name of entity supplying water to the irrigation district*) notifies the district that water deliveries will be limited to ______________ acre-feet per year (*i.e. a level below that required for unrestricted irrigation*).

Section VII: Termination of Water Allocation

The district's water allocation policies will remain in effect until the conditions defined in Section IV of the Plan no longer exist and the Board deems that the need to allocate water no longer exists.

Section VIII: Notice

Notice of the initiation of water allocation will be given by notice posted on the District's public bulletin board and by mail to each _________________________ (*example: landowner, holders of active irrigation accounts, etc.*).

Section IX: Water Allocation

(a) In identifying **specific, quantified targets** for water allocation to be achieved during periods of water shortages and drought, each irrigation user shall be allocated _______________ irrigations or _______________ acre-feet of water each flat rate acre on which all taxes, fees, and charges have been paid. The water allotment in each irrigation account will be expressed in acre-feet of water.

Include explanation of water allocation procedure. For example, in the Lower Rio Grande Valley, an "irrigation" is typically considered to be equivalent to eight (8) inches of water per irrigation acre; consisting of six (6) inches of water per acre applied plus two (2) inches of water lost in transporting the water from the river to the land. Thus, three irrigations would be equal to 24 inches of water per acre or an allocation of 2.0 acre-feet of water measured at the diversion from the river.

(b) As additional water supplies become available to the District in an amount reasonably sufficient for allocation to the District's irrigation users, the additional water made available to the District will be equally distributed, on a pro rata basis, to those irrigation users having ____.

Example 1: An account balance of less than _______________ irrigations for each flat rate acre (*i.e.* _______________ *acre-feet*).

Example 2: An account balance of less than _______________ acre-feet of water for each flat rate acre.

Example 3: An account balance of less than _______________ acre-feet of water.

(c) The amount of water charged against a user's water allocation will be _______________ (*example: eight inches*) per irrigation, or one allocation unit, unless water deliveries to the land are metered. Metered water deliveries will be charges based on actual measured use. In order to maintain parity in charging use against a water allocation between non-metered and metered deliveries, a loss factor of _______________ percent of the water delivered in a metered situation will be added to the measured use and will be charged against the user's water allocation. Any metered use, with the loss factor applied, that is less than eight (8) inches per acre shall be credited back to the allocation unit and will be available to the user. It shall be a violation of the Rules and Regulations for a water user to use water in excess of the amount of water contained in the user's irrigation account.

(d) Acreage in an irrigation account that has not been irrigated for any reason within the last two (2) consecutive years will be considered inactive and will not be allocated water. Any landowner whose land has not been irrigated within the last two (2) consecutive years, may, upon application to the District expressing intent to irrigate the land, receive future allocations. However, irrigation water allocated shall be applied only upon the acreage to which it was allocated and such water allotment cannot be transferred until there have been two consecutive years of use.

Section X: Transfers of Allotments

(a) A water allocation in an active irrigation account may be transferred within the boundaries of the District from one irrigation account to another. The transfer of water can only be made by the landowner's agent who is authorized in writing to act on behalf of the landowner in the transfer of all or part of the water allocation from the described land of the landowner covered by the irrigation account.

(b) A water allocation may not be transferred to land owned by a landowner outside the District boundaries.

or

A water allocation may be transferred to land outside the District's boundaries by paying the current water charge as if the water was actually delivered by the District to the land covered by an irrigation account. The amount of water allowed to be transferred shall be stated in terms of acre-feet and deducted from the landowner's current allocation balance in the irrigation account. Transfers of water outside the District shall not affect the allocation of water under Section VII of these Rules and Regulations.

(c) Water from outside the District may not be transferred by a landowner for use within the District.

or

Water from outside the District may be transferred by a landowner for use within the District. The District will divert and deliver the water on the same basis as District water is delivered, except that a ______________ percent conveyance loss will be charged against the amount of water transferred for use in the District as the water is delivered.

Section XI: Penalties

Any person who willfully opens, closes, changes or interferes with any headgate or uses water in violation of these Rules and Regulations, shall be considered in violation of Section 11.0083, Texas Water Code, *Vernon's Texas Codes Annotated*, which provides for punishment by fine of not less than $10.00 nor more than $200.00 or by confinement in the county jail for not more than thirty (30) days, or both, for each violation, and these penalties provided by the laws of the State and may by enforced by complaints filed in the appropriate court jurisdiction in ________________________ County, all in accordance with Section 11.083; and in addition, the District may pursue a civil remedy in the way of damages and/or injunction against the violation of any of the foregoing Rules and Regulations.

Section XII: Severability

It is hereby declared to be the intention of the Board of Directors of the ________________________ (*name of irrigation district*) that the sections, paragraphs, sentences, clauses, and phrases of this Plan shall be declared unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs, and sections of this Plan, since the same would not have been enacted by the Board without the incorporation into this Plan of any such unconstitutional phrase, clause, sentence, paragraph, or section.

Section XIII: Authority

The foregoing rules and regulations are adopted pursuant to and in accordance with Sections 11.039, 11.083, 11.1272; Section 49.004; and Section 58.127-130 of the Texas Water Code, *Vernon's Texas Codes Annotated.*

Section XIV: Effective Date of Plan

The effective date of this Rule shall be five (5) days following the date of Publication hereof and ignorance of the Rules and Regulations is not a defense for a prosecution for enforcement of the violation of the Rules and Regulations.

EXAMPLE RESOLUTION FOR ADOPTION OF A DROUGHT CONTINGENCY PLAN

RESOLUTION NO. __________

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE ___________________ (name of water supplier) ADOPTING A DROUGHT CONTINGENCY PLAN.

WHEREAS, the Board recognizes that the amount of water available to the ____________ (*name of water supplier*) and its water utility customers is limited and subject to depletion during periods of extended drought;

WHEREAS, the Board recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes;

WHEREAS, Section 11.1272 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the _________________ (*name of water supply system*), the Board deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE _________________ (*name of water supplier*):

SECTION 1. That the Drought Contingency Plan attached hereto as Exhibit A and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the ________________ (*name of water supplier*).

SECTION 2. That the _______________ (*example: general manager*) is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.

DULY PASSED BY THE BOARD OF DIRECTORS OF THE _______________, ON THIS __ day of ______________, 20__.

____
President, Board of Directors

ATTESTED TO:

____
Secretary, Board of Directors

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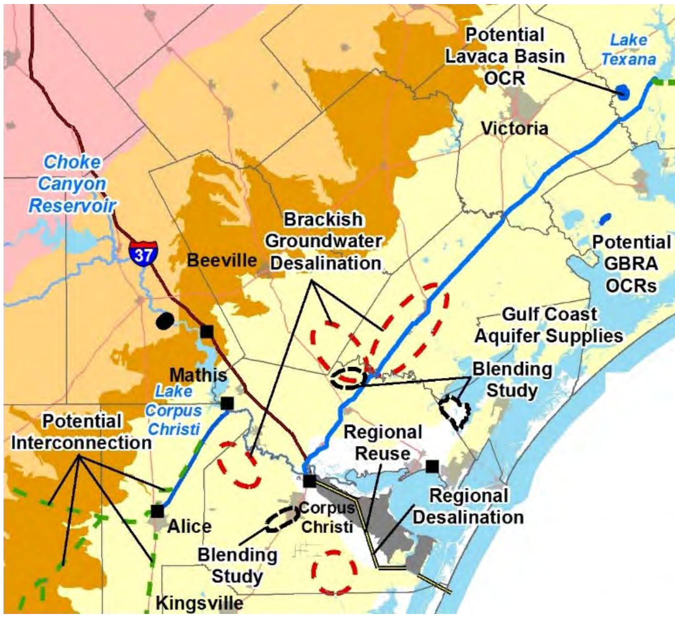

Appendix E

Status of Implementation of Projects Identified in the 2016 Plan

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Planning Region	WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Implementation Survey Record Type	Database ID	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)
N	ADDITIONAL CARRIZO AQUIFER - MCMULLEN MINING	2020	PROJECT SPONSOR(S): MINING (MCMULLEN)	RECOMMENDED WMS PROJECT	2417	Yes	2019	2018	All phases fully implemented		Not applicable
N	ADDITIONAL GULF COAST AQUIFER - MCMULLEN MINING	2020	PROJECT SPONSOR(S): MINING (MCMULLEN)	RECOMMENDED WMS PROJECT	1713	No			Not implemented		Not applicable
N	ALICE-STWA INTERCONNECTIONS	2020	PROJECT SPONSOR(S): ALICE	RECOMMENDED WMS PROJECT	2550	No			Not implemented	If other, please describe.	Not applicable
N	BRACKISH GROUNDWATER DEVELOPMENT - ALICE	2020	PROJECT SPONSOR(S): ALICE	RECOMMENDED WMS PROJECT	2091	Yes	2019	2020	Under construction		
N	CHASE WELL FIELD - BEEVILLE	2020	PROJECT SPONSOR(S): BEEVILLE	RECOMMENDED WMS PROJECT	1676	Yes	2019	2020	All phases fully implemented		
N	GULF COAST AQUIFER SUPPLIES - MCMULLEN IRRIGATION	2020	PROJECT SPONSOR(S): IRRIGATION (MCMULLEN)	RECOMMENDED WMS PROJECT	1716	No			Not implemented	Not needed	
N	IRRIGATION WATER CONSERVATION	2020	WUG REDUCING DEMAND: IRRIGATION, MCMULLEN	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9194	No					
N	LOCAL BALANCING STORAGE - ROBSTOWN	2020	PROJECT SPONSOR(S): NUECES COUNTY WCID #3	RECOMMENDED WMS PROJECT	2093	Yes	2019		Feasibility study ongoing		
N	MANUFACTURING WATER CONSERVATION	2020	WUG REDUCING DEMAND: MANUFACTURING, NUECES	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9198						
N	MANUFACTURING WATER CONSERVATION	2020	WUG REDUCING DEMAND: MANUFACTURING, SAN PATRICIO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9210	Yes	2016		Currently operating		
N	MANUFACTURING WATER CONSERVATION	2020	WUG REDUCING DEMAND: STEAM ELECTRIC POWER, NUECES	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9204						
N	MCMULLEN COUNTY MINING MINOR AQUIFER DEVELOPMENT	2020	PROJECT SPONSOR(S): MINING (MCMULLEN)	RECOMMENDED WMS PROJECT	2551	Yes	2019	2018	All phases fully implemented		
N	MINING WATER CONSERVATION	2020	WUG REDUCING DEMAND: MINING, MCMULLEN	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9190	No			Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: ALICE	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6944	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: BEEVILLE	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6946	Yes	2014	2019	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: BENAVIDES	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6948						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: FALFURRIAS	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6950	Yes	1999	2020	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: FREER	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6952						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: GEORGE WEST	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6954						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: ORANGE GROVE	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6956						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: PREMONT	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6958						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: SAN DIEGO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6960						
N	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: THREE RIVERS	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6962	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: BISHOP	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6833	Yes	2018	2023	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: COUNTY-OTHER, KENEDY	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6835						
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: COUNTY-OTHER, KLEBERG	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6837						
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: FULTON	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6839	Yes	2015	2020	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: GREGORY	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6841	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: PORT ARANSAS	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6845	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: PORTLAND	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6847	Yes	2015	2020	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: RIVER ACRES WSC	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6849	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: ROBSTOWN	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6851	Yes	2019	2024	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: ROCKPORT	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6853	Yes	2015	2020	Sponsor has taken official action to initiate project		
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)	2020	WUG REDUCING DEMAND: SINTON	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6855						
N	MUNICIPAL WATER CONSERVATION (URBAN)	2020	WUG REDUCING DEMAND: CORPUS CHRISTI	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	6791	Yes	2019		Sponsor has taken official action to initiate project		
N	O.N. STEVENS WTP IMPROVEMENTS	2020	PROJECT SPONSOR(S): CORPUS CHRISTI	RECOMMENDED WMS PROJECT	2415	Yes	2019	2021	Under construction		
N	PORTLAND REUSE PIPELINE	2020	PROJECT SPONSOR(S): SAN PATRICIO MWD	RECOMMENDED WMS PROJECT	2618	No			Not implemented	Sherwin Alumina bankrupt. N	Political support/governance
N	SPMWD INDUSTRIAL WTP IMPROVEMENTS	2020	PROJECT SPONSOR(S): SAN PATRICIO MWD	RECOMMENDED WMS PROJECT	2414	Yes	2019	2020	Under construction		
N	WELL CONVERSION PROJECT - BEEVILLE	2020	PROJECT SPONSOR(S): BEEVILLE	RECOMMENDED WMS PROJECT	1677	Yes	2019	2020	Acquisition and design phase		
N	ADDITIONAL REUSE - CORPUS CHRISTI	2030	PROJECT SPONSOR(S): CORPUS CHRISTI	RECOMMENDED WMS PROJECT	2096	Yes		2030	Feasibility study ongoing		
N	GULF COAST AQUIFER SUPPLIES - SAN DIEGO	2030	PROJECT SPONSOR(S): SAN DIEGO	RECOMMENDED WMS PROJECT	1678						
N	PIPELINE REPLACEMENT PROGRAM (ALICE)	2030	PROJECT SPONSOR(S): ALICE	RECOMMENDED WMS PROJECT	2631	No		2030	Not implemented	Too soon	Not applicable
N	REUSE - ALICE	2030	PROJECT SPONSOR(S): ALICE	RECOMMENDED WMS PROJECT	2092	No		2030	Not implemented	Too soon	Not applicable
N	SEAWATER DESALINATION	2030	PROJECT SPONSOR(S): CORPUS CHRISTI	RECOMMENDED WMS PROJECT	2097	Yes	2019	2030	Acquisition and design phase		
N	GULF COAST AQUIFER DEVELOPMENT - SAN PAT IRRIGATION	2050	PROJECT SPONSOR(S): IRRIGATION (SAN PATRICIO)	RECOMMENDED WMS PROJECT	2098	Yes	2018		All phases fully implemented		
N	IRRIGATION WATER CONSERVATION	2050	WUG REDUCING DEMAND: IRRIGATION, SAN PATRICIO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	9216	Yes	2018		Currently operating		

Planning Region	WMS or WMS Project Name	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)	Year the project is online?*	Is this a phased project?*	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
N	ADDITIONAL CARRIZO AQUIFER - MCMULLEN MINING			$ 1,000,000.00								No	No	No	
N	ADDITIONAL GULF COAST AQUIFER - MCMULLEN MINING											No	No	No	
N	ALICE-STWA INTERCONNECTIONS											No	No	No	
N	BRACKISH GROUNDWATER DEVELOPMENT - ALICE			$ 17,062,500.00	2020	Yes	3363	17062500	2025	TWDB - Other	SRF	Yes	No	No	
N	CHASE WELL FIELD - BEEVILLE	1460			2020							No	No	No	
N	GULF COAST AQUIFER SUPPLIES - MCMULLEN IRRIGATION											No	No	No	
N	IRRIGATION WATER CONSERVATION											No	No	No	
N	LOCAL BALANCING STORAGE - ROBSTOWN											Yes	No	No	
N	MANUFACTURING WATER CONSERVATION											Yes	No	No	
N	MANUFACTURING WATER CONSERVATION											Yes	No	No	
N	MANUFACTURING WATER CONSERVATION											No	No	No	
N	MCMULLEN COUNTY MINING MINOR AQUIFER DEVELOPMENT											No	No	No	
N	MINING WATER CONSERVATION											No	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											No	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (RURAL)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						No	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						No	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)					Yes						Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (SUBURBAN)											Yes	No	No	
N	MUNICIPAL WATER CONSERVATION (URBAN)											Yes	No	No	
N	O.N. STEVENS WTP IMPROVEMENTS	44840		$ 68,200,000.00	2021	No			2025	TWDB - Other		Yes	No	No	
N	PORTLAND REUSE PIPELINE											No	No	No	
N	SPMWD INDUSTRIAL WTP IMPROVEMENTS		$ 1,500,000.00	$ 2,500,000.00	2020	No				Other	Cash	No	No	No	
N	WELL CONVERSION PROJECT - BEEVILLE					No						No	No	No	
N	ADDITIONAL REUSE - CORPUS CHRISTI					Yes						No	No	No	
N	GULF COAST AQUIFER SUPPLIES - SAN DIEGO											Yes	No	No	
N	PIPELINE REPLACEMENT PROGRAM (ALICE)					Yes							No	No	
N	REUSE - ALICE			$ 10,200,000.00		No						Yes	No	No	
N	SEAWATER DESALINATION					Yes	33630	298000000	2035	TWDB - SWIFT		Yes	No	No	
N	GULF COAST AQUIFER DEVELOPMENT - SAN PAT IRRIGATION											Yes	No	No	
N	IRRIGATION WATER CONSERVATION											Yes	No	No	

Appendix F

Comments Received on the Initially Prepared Plan and Responses

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The Region N Initially Prepared Plan was adopted by Region N on February 20, 2020 and submitted to the TWDB in March 2020, according to schedule.

The public hearing on the Initially Prepared Plan was originally scheduled for April 23, 2020. Upon receipt of comments from the public and planning group members requesting more time for public review of the draft plan due to a change to virtual meeting format in response to governor's orders, the public hearing was rescheduled for June 2nd. This provided an additional 6 weeks for public review and comment prior to public hearing. The public hearing was held virtually on June 2nd. Public comment period closed August 1, 2020 (60 days after hearing).

The table below summarizes comments received from agencies, stakeholders, and the public. The Region N RWPG reviewed these comments and adopted the attached responses on September 3, 2020. The federal and state agency comments and responses are included first, with responses following agency comments. The public comments received are grouped according to subject matter in this packet, with responses following each subject matter section. The chapters in the Final Plan were updated or revised accordingly to address comments, as indicated.

Federal and State Agency comments received on Region N IPP		
Respondent	*Additional info*	*Subject matter*
TWDB comments	email 6/16/2020	Tier 1 & 2 comments
Texas Parks and Wildlife	letter dated 8/7/2020	Env impacts, general, etc
Texas State Soil and Water Conservation Bo	email 6/18/2020	brush management
Public comments received on Region N IPP (comment period close: 8/1/2020)		
Respondent	*Additional info*	*Subject matter*
Donna Rosson (prior to IPP)	discussed by subcommittee 7/23	Legislative and policy recommendations
Marvin Townsend	delivered in person to HDR 4/23/2020	Three Rivers
Errol Summerlin (on behalf of Coastal Alliance to Protection our Environment)	letter dated 4/12/2020	Public hearing format
Donna Rosson & Teresa Carrillo	email 4/13/2020	Public hearing format
Encarnacion Serna Jr	submitted 7/28/2020	Population Growth
Hamlet Newsom	email to HDR 5/5, 5/6, 5/28, 7/16/2020	Groundwater and Seawater desalination
Randy Cain	submitted 6/22/2020; same as E Nye comment	Seawater desalination
Emily Nye	submitted 6/25/2020	Seawater desalination
Patrick Nye	submitted 6/24/2020; also 6/26/2020 same as E Nye comment	Seawater desalination
Patrick Nye	submitted 8/1/2020; letter and accompanying slides	Seawater desalination
Encarnacion Serna Jr	submitted 7/28/2020; two attachments	Desalination
Errol Summerlin	submitted 8/1/2020	Seawater desalination
Kathryn Masten	submitted 7/23/2020	Seawater desalination
Kathryn Masten (on behalf of Ingleside on the Bay Coastal Watch Association)	submitted 8/1/2020	Seawater desalination
Cliff Schlabach and Neil McQueen (on behalf of Surfrider Foundation)	letter dated 7/20/2020; received 8/3/2020	Seawater desalination
Wendy Hughes	submitted 6/5/2020	Seawater desalination
Jennifer Hillard	submitted 6/2/2020	Seawater desalination
Andrew Sowder	email to Carola Serrato 6/9/2020	Atmospheric water generation technology

TWDB comments (received 6/16/2020)

Note: Responses embedded in comment document (see italics)

Texas Water Development Board

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Ms. Carola Serrato, Co-Chair
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P.O. Box 1701
Kingsville, Texas 78364

Mr. John Byrum
Nueces River Authority
602 N. Staples St, #280
Corpus Christi, Texas 78401

Mr. Scott Bledsoe III, Co-Chair
c/o Live Oak UWCD
P.O. Box 3
Oakville, TX 78060

Re: Texas Water Development Board Comments for the Coastal Bend (Region N) Regional Water Planning Group Initially Prepared Plan, Contract No. 1548301842

Dear Ms. Serrato, Mr. Bledsoe, and Mr. Byrum:

Texas Water Development Board (TWDB) staff have completed their review of the Initially Prepared Plan (IPP) submitted by March 3, 2020 on behalf of the Coastal Bend Regional Water Planning Group (RWPG). The attached comments follow this format:

- **Level 1:** Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and,

- **Level 2:** Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

Please note that rule references are based on recent revisions to 31 Texas Administrative Code (TAC) Chapter 357, adopted by the TWDB Board on June 4, 2020. 31 TAC § 357.50(f) requires the RWPG to consider timely agency and public comment. Section 357.50(g) requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan (*Contract Exhibit C, Section 13.1.2)*.
Standard to all planning groups is the need to include certain content in the final regional water plans that was not yet available at the time that IPPs were prepared and submitted. In your final regional water plan, please be sure to also incorporate the following:

a) Completed results from the RWPG's infrastructure financing survey for sponsors of recommended projects with capital costs, including an electronic version of the survey spreadsheet *[31 TAC § 357.44]*;
b) Completed results from the implementation survey, including an electronic version of the survey spreadsheet *[31 TAC § 357.45(a)]*;
c) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC § 357.50(f)]*; and
d) Evidence, such as a certification in the form of a cover letter, that the final, adopted regional water plan is complete and adopted by the RWPG *[31 TAC § 357.50(h)(1)]*.

Please ensure that the final plan includes updated state water planning database (DB22) reports, and that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB22. For the purpose of development of the 2022 State Water Plan, water management strategy and other data entered by the RWPG in DB22 shall take precedence over any conflicting data presented in the final regional water plan *[Contract Exhibit C, Sections 13.1.3 and 13.2.2]*.

Additionally, subsequent review of DB22 data is being performed. If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve. Please anticipate the need to respond to additional comments regarding data integrity, including any source overallocations, prior to the adoption of the final regional water plans.

The provision of certain content in an electronic-only form is permissible as follows: Internet links are permissible as a method for including model conservation and drought contingency plans within the final regional water plan; hydrologic modeling files may be submitted as electronic appendices, however all other regional water plan appendices should also be incorporated in hard copy format within each plan *[31 TAC § 357.50(g)(2)(C), Contract Exhibit C, Section 13.1.2 and 13.2.1]*.

The following items must accompany, the submission of the final, adopted regional water plan:

1. The prioritized list of all recommended projects in the regional water plan, including an electronic version of the prioritization spreadsheet *[31 TAC § 357.46];* and,
2. All hydrologic modeling files and GIS files, including any remaining files that may not have been provided at the time of the submission of the IPP but that were used in developing the final plan *[31 TAC § 357.50(g)(2)(C), Contract Exhibit C, Section 13.1.2, and 13.2.1].*

The following general requirements that apply to recommended water management strategies must be adhered to in all final regional water plans including:

1. Regional water plans must not include any recommended strategies or project costs that are associated with simply maintaining existing water supplies or replacing existing infrastructure. Plans may include only infrastructure costs that are

associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies *[31 TAC § 357.10(39), § 357.34(e)(3)(A), Contract Exhibit C, Sections 5.5.2 and 5.5.3]*; and,

2. Regional water plans must not include the costs of any retail distribution lines or other infrastructure costs that are not directly associated with the development of additional supply volumes (e.g., via treatment) other than those line replacement costs related to projects that are for the primary purpose of achieving conservation savings via water loss reduction *[§ 357.34(e)(3)(A), Contract Exhibit C, Section 5.5.3]*.

Please be advised that, within the attached document, your region has received a comment specifically requesting that the RWPG provide the basis for how the RWPG considers it feasible that certain water management strategies will actually be implemented by January 5, 2023 (see Level 1, Comment 1), especially for projects with long lead times. This comment is aimed at making sure RWPGs do not present projects in their plans to provide water during the 2020 decade that cannot reasonably be expected to be online, *and provide water supply*, by January 5, 2023. For project types whose drought yields rely on *previously stored water*, the 2020 supply volume should take into consideration reasonably expected accumulated storage that would already be available in the event of drought. The RWPG must adequately address this Level 1 comment in the final, adopted regional water plan, which might require making changes to your regional plan.

It is preferable that RWPGs adopt a realistic plan that acknowledges the likelihood of unmet needs in a near-term drought, rather than to present a plan that overlooks reasonably foreseeable, near-term shortages due to the inclusion of unrealistic project timelines. If a '2020' decade project cannot reasonably be expected to come online by January 2023, for example if a reservoir has not started the permitting process, it should be moved to the 2030 decade. Any potential supply gaps (unmet needs) created by moving out projects to the 2030 decade may be shown as simply 'unmet' in the 2020 decade or be shown as met by a 'demand management' strategy. Doing so will appropriately reflect the fact that some entities would likely face an actual shortage if a drought of record were to occur in the very near future despite projects (that may be included in the plan but associated with a later decade) that will eventually address those same potential shortages in future years.

It is imperative that you provide the TWDB with information on how you intend to address this comment and all other comments well in advance of your adoption the regional water plan to ensure that the response is adequate for the Executive Administrator to recommend the plan to the TWDB Board for consideration in a timely and efficient manner. Your TWDB project manager will review and provide feedback to ensure all IPP comments and associated plan revisions have been addressed adequately. Failure to adequately address this comment (or any Level 1

comment) may result in the delay of the TWDB Board approval of your final regional water plan.

As a reminder, the deadline to submit the final, adopted regional water plan and associated material to the TWDB is **October 14, 2020**. Any remaining data revisions to DB22 must be communicated to Sabrina Anderson at Sabrina.Anderson@twdb.texas.gov by **September 14, 2020.**

If you have any questions regarding these comments or would like to discuss your approach to addressing any of these comments, please do not hesitate to contact Kevin Smith at (512) 475-1561 or Kevin.Smith@twdb.texas.gov. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Jessica Zuba
Deputy Executive Administrator
Water Supply and Infrastructure

Date: 6/15/2020

Attachment

c w/att.: Ms. Kristi Shaw, HDR, Inc.

TWDB comments on the Initially Prepared 2021 Coastal Bend (Region N) Regional Water Plan

Level 1: Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Chapter 5 and the State Water Planning Database (DB22). The plan includes the following recommended water management strategies (WMS) by WMS type, providing supply in 2020 (not including demand management): *one aquifer storage & recovery*, 24 *groundwater wells & other*, two *groundwater desalination*, one *other direct reuse*, two *seawater desalination*, and two *other surface water*. **Strategy supply with an online decade of 2020 must be constructed and delivering water by January 5, 2023.**

a) Please confirm that all strategies shown as providing supply in 2020 are expected to be providing water supply by January 5, 2023. [31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]
Response: Yes, strategies shown as providing supply in 2020 are expected to be providing water by January 2023. Additional efforts were made to confirm timing. For strategies with long lead project implementation lead times, HDR reached out directly to sponsors and/or water providers to discuss implementation plans (see b) below).

The following assumptions were made for water conservation or small-scale groundwater projects, for which contact information was unavailable or impractical to survey:

- Irrigation water conservation projects are on-going by many irrigators in the region and water savings continue to be shown in Year 2020 (2.5% reduction in water demand) and onward.
- Gulf coast water supplies for rural municipal water systems, irrigation, manufacturing, and mining water users (typically 1-4 well projects) continue to be reported in 2020 if needs are shown with the understanding that these water users will develop supplies as needed to meet current customer demands. In many cases, the water management strategy is shown for a county-wide user group for which contact information is unavailable.

b) Please provide the specific basis on which the planning group anticipates that it is feasible that the aquifer storage and recovery, two groundwater desalination, two seawater desalination, and two other surface water WMSs will all actually be online and providing water supply by January 5, 2023. For example, provide information on actions taken by sponsors and anticipated future project milestones that demonstrate sufficient progress toward implementation. [31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]
Response: After talking with project sponsors, the following projects will be deferred to 2030:

- City of Corpus Christi Aquifer Storage and Recovery
- Seawater Desalination- Port (Harbor Island)
- Seawater Desalination- Corpus Christi (Inner Harbor)
- Evangeline/Laguna LP Treated Groundwater

We were unable to reach Nueces County WCID 3 for project status of local balancing storage reservoir, which will continue to be shown for Year 2020.

We confirmed with project sponsors that these projects are actively in progress and expected to deliver water by January 5, 2023:

- City of Alice- Brackish Groundwater Desalination
  - Phase I in progress, including planning, engineering, permitting, environmental, and construction of test well & production well. Received Drinking Water State Revolving Fund (DWSRF) funding.
  - Phase II will follow with construction of a 3.0 million gallon per day brackish desalination plant, one 2 million gallon per day brackish production well, building, yard piping, well construction lines and concentrate discharge line. The City rolled forward the project information form submitted to TWDB for Phase II, for consideration during TWDB's 2021 fiscal year for DWSRF funding.
  - The City of Alice issued an RFP for alternate groundwater delivery services for Phase II and received two proposals. At the August 18, 2020 City Council Meeting, the City Council authorized the City Manager to negotiate with Seven Seas for financing, designing, building, owning, operating and maintaining the brackish desalination plant. According to Seven Seas, plant is estimated to be fully operational in 18 months after construction begins (https://sevenseaswater.com/seven-seas-water-selected-as-winning-bidder-for-p3-brackish-water-desalination-plant-in-texas/)
- O.N. Stevens WTP Improvements
  - Construction in progress

c) In the event that the resulting adjustment of the timing of WMSs in the plan results in an increase in near-term unmet water needs, please update the related portions of the plan and DB22 accordingly, and also indicate whether 'demand management' will be the WMS used in the event of drought to address such water supply shortfalls or if the plan will show these as simply 'unmet'. If municipal shortages are left 'unmet' and without a 'demand management' strategy to meet the shortage, please also ensure that adequate justification is included in accordance with 31 TAC § 357.50(j). [TWC § 16.051(a); 31 § TAC 357.50(j); [31 TAC § 357.34(i)(2); Contract Exhibit C, Section 5.2]
Response: Noted.

d) Please be advised that, in accordance with Senate Bill 1511, 85th Texas Legislature, the planning group will be expected to rely on its next planning cycle budget to amend its 2021 Regional Water Plan during development of the 2026 Regional Water Plan, if recommended WMSs or projects become infeasible, for example, do to timing of projects coming online. Infeasible WMSs include those WMSs where proposed sponsors have not taken an affirmative vote or other action to make expenditures necessary to construct

or file applications for permits required in connection with implementation of the WMS on a schedule in order for the WMS to be completed by the time the WMS is needed to address drought in the plan [Texas Water Code *§ 16.053(h)(10); 31 TAC § 357.12(b)*]
Response: Noted.

2. Section 2.4, Table 2.11. Please revise the section and table headers referring to "Wholesale Water Providers" to "Major Water Providers" in the final, adopted regional water plan. *[31 TAC § 357.31(b); 31 TAC § 357.31(f)]*
Response: Revise 2.4 section header and Table 2.11 to "Major Water Providers" as suggested.

3. Section 3.1.8, page 3-12. This section states that the planning group elected not to designate any major water providers (MWP), however Section 1.4 identifies four MWPs that appear to have been designated at the 11/9/17 Region N meeting. Please reconcile this information in the final, adopted regional water plan. *[31 TAC § 357.32(g)]*
Response: Revise last sentence of Section 3.1.8 and additional description to read: The Coastal Bend Regional Water Planning Group considered this provision at the November 9, 2017 meeting. Four Wholesale Water Providers (City of Corpus Christi, SPMWD, STWA and Nueces County WCID 3) currently provide about 75% of the total water for Region N. For this reason, these existing four Wholesale Water Providers are considered major water providers.

   At the January 16, 2020 meeting, the Coastal Bend Regional Water Planning Group approved inclusion of two seawater desalination water management strategy projects as recommended strategies that would be served by new water providers: Port of Corpus Christi Authority (PCCA) and Poseidon Water. Although these are not current major water providers, they have are identified as potential future wholesale water providers as discussed previously in Section 1.4.

4. Section 3.1.8. Please include existing supplies for MWPs in Chapter 3, at a minimum by reference to the location elsewhere in the document, in the final, adopted regional water plan. *[31 TAC § 357.32(g)].*
Response: Add sentence at the end of Section 3.1.8 to read: Existing supplies for the four current major water providers (i.e. WWPs) by decade and category of use is provided in Table 4A.24.

5. Section 3.3. Please confirm whether the local surface water supplies listed in Table 3.4 are firm supplies under drought conditions in the final, adopted regional water plan. *[31 TAC § 357.32(a); Contract Exhibit C, Section 3.2]*
Response: Yes. A sentence will be added in Section 3.3 (page 3-16) to read: The livestock local surface water supplies presented in Table 3.4 were identified based on 2010 use (as discussed in the 3rd sentence in 3rd paragraph on page 3-16) and considered firm supplies under drought conditions.

6. Section 4A.4, Table 4A.24. Please revise the section and table headers referring to "Wholesale Water Provider" to "Major Water Provider" in the final, adopted regional water plan. *[31 TAC § 357.33(b)]*
Response: Revise section header and Table 4A.24 to "Major Water Provider" as suggested.

7. Chapter 4. The plan does not appear to include a secondary needs analysis for MWPs. Please present the results of the secondary needs analysis by decade for MWPs in the final, adopted regional water plan. *[31 TAC § 357.33(e)]*
   Response: Appendix A includes Region N Second-Tier needs analysis for Water User Groups (WUG). This information will be assimilated at MWP level and included in final plan. Sentence will be added to Chapter 4 to read: "Secondary needs (i.e. second-tier needs) were calculated by TWDB for WUGs based on State Water Planning Database (DB22) entries and is included in Appendix A. Using this information, a secondary needs analysis was summarized for major water providers as shown in Table 4A.25.

8. Chapter 5, page 5-9. The plan states that the TWDB-provided tables for management supply factors are not available at this time. However, the management supply factor table for WUGs is included in in the IPP in Appendix A as a DB22 report. The planning group must also report the management supply factors for MWPs. Please clarify this information and report the management supply factors for MWPs in the final, adopted regional water plan. *[31 TAC § 357.35(g)(2)]*
   Response: Management supply factors for the four current MWPs will be included in final plan. Revise sentence on page 5-9 to read: The TWDB –provided table that shows calculated management supply factors for each decide for each WUG is included in Appendix A. Using this information, management supply factors were summarized for major water providers and is presented in Table 5B.1.6.

9. Section 5D.5 and DB22. The plan includes a WMS project for the City of Alice – Non Potable Reuse that appears to come online (2030) after the related City of Alice – Non Potable Reuse WMS (that relies on the project) is initially online providing supply (2020). For WMS projects that are necessary for a strategy to deliver water, please ensure that the project is associated with the initial decade, or earlier decade, that the strategy is delivering supply. In the event that the resulting adjustment of the timing of WMSs in the plan results in an increase in near-term unmet water needs, please update the related portions of the plan and DB22 accordingly. *[31 TAC § 357.10(21); Contract Exhibit C, Section 5.2]*
   Response: Based on feedback from project sponsor, this project will be shown in 2030. Will verify in Plan and DB22 that this strategy is shown consistent for 2030.

10. Section 5D.6. Please clarify whether the Local Balancing Storage Reservoir WMS is anticipated to be subject to a surface water right amendment, and if so, please clarify if or how the TCEQ's adopted environmental flow standards were considered in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(B); 31 TAC § 358.3(22); 31 TAC § 358.3(23)]*
    Response: A sentence will be added to Section 5D.6 to clarify amendments needed as follows: The water right will have to be amended to include the off-channel storage, however the existing authorized diversions from the river will not have to be amended and since they are already authorized they are not subject to TCEQ flow standards.

11. Section 5D.7. The plan does not appear to define a threshold for significant identified water needs for assessing the potential for aquifer storage and recovery (ASR) projects. Please include information on how the planning groups defines significant water need for the potential for ASR projects to meet those needs in the final, adopted regional water plan. *[TWC § 16.053(e)(10); 31 TAC § 357.34(h)]*
    Response: Text has been revised in Section 4A.1 to address this comment. Region N considers significant water needs to be equal or greater than 20,000 ac-ft/yr. The Initially Prepared Region N Plan includes ASR as an evaluated strategy (Section 5D.7) and

recommended WMS to meet future manufacturing needs in the Nueces County area as sponsored by the City of Corpus Christi.

12. Chapter 5. The evaluations of potentially feasible WMSs and associated projects do not appear to include a quantitative reporting of all environmental factors. For example, the Impacts to Environmental Factors Key in Table 5B.1.4 does not appear to assign quantitative values to impacts on wildlife habitat, wetlands, threatened and endangered species, and cultural resources. Additionally, the evaluation summary tables in each 5D subsection refer to qualitative impacts. Please include a quantitative reporting of environmental factors for each WMS in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(B)]*
Response: The environmental factors key in Table 5B.1.4 will be updated, as follows (changes italicized). Evaluation summary tables at the end of each water management strategy description (Chapter 5D.1- 5D.11) will be updated, if needed, for environmental water needs (b.1; b.4; b.5), wildlife habitat (b.3), cultural resources (b.6), and Bay and Estuary Inflows and arms of the Gulf of Mexico (b.2) to be consistent with Table 5B.1.4.

Table 5B.1.4.
Impacts to Environmental Factors Key

Impacts to Environmental Factors Key	**Criteria**
None or Low; Negligible	Reduction in environmental flows with implementation of the strategy is indiscernible (less than 1%) using the approved surface water availability model, as compared to instream, Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Wildlife habitat is not expected to be altered by the project. Wetlands are not expected to be altered (< 1% alteration) with project implementation. Threatened and endangered species habitat are not expected to be altered (< 1% alteration) with project implementation. Cultural resources are not expected to be altered with project implementation. .
Moderate; Some	Reduction in environmental flows with implementation of the strategy is expected to range from 1% to 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Due to the nature of the strategy, localized impacts to small creeks or on-site tanks may be noticed (up to 10%). Wildlife habitat may be temporarily impacted during project construction (less than 10% area), but long-term impacts to wildlife habitat are not expected. Wetlands may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Threatened and endangered species habitat may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Cultural resources are not expected to be altered with project implementation.
High	Reduction in environmental flows with implementation of the strategy is expected to exceed 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Long-term wildlife habitat alteration (of 10% or greater) is highly likely with project. Permanent wetlands (of 20% or more current wetland area) is highly likely with project implementation. Threatened and endangered species habitat is highly likely (20% or more of habitat area) with project implementation. Cultural resources are highly likely to be altered with project implementation. .

13. Chapter 5. The evaluations of potentially feasible WMSs and associated projects do not appear to include a full quantitative reporting of impacts to agricultural resources. For example, the agricultural resources key in Table 5B.1.5 does not include quantifying criteria for the 'None or Low; Negligible' impacts. Please include quantitative reporting for the 'None or Low; Negligible" impacts to agricultural resources for each WMS in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(C)]*
Response: The agricultural resources key in Table 5B.1.5 will be updated, as follows, for 'None or Low; Negligible' impacts (changes italicized). Evaluation summary tables at the end of each water management strategy description (Chapter 5D.1- 5D.11) will be updated, if needed, to be consistent with Table 5B.1.5.

Table 5B.1.5.
Impacts to Agricultural Resources Key

Impacts to Agricultural Resources Key	Criteria
None or Low; Negligible	Temporary impacts to agricultural land during project construction. Occasion disturbances due to maintenance on right of way for pipelines. Less than 5 irrigated acres permanently affected due to repurposing of land to support the project.
Moderate; Some	Loss of up to 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).
High	Loss of more than 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).

14. Chapter 5. The plan does not appear to indicate how WMS yields took into account anticipated water losses. Please include this information in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.2.3]*
Response: Water losses associated with recommended WMS are anticipated to be negligible with routine, standard maintenance performed to extend project life. In accordance with TWDB guidance, water plans should not include project costs associated with maintenance of replacing existing infrastructure.

15. The WMS Project vector data was submitted across more than one shapefile/feature class for the same feature type. The vector data must be divided into point, line, and polygon feature types across a maximum of three shapefiles in a single folder or three feature classes in a single file geodatabase (one for each feature type). Please combine all feature classes in the 'RegionN' GBD into a single feature class for each feature type in the final GIS data submitted. *[Contract Exhibit D, Section 2.4.5]*
Response: Final GIS data will be submitted, in format according to comment.

16. Appendix A. The plan includes some DB22 reports that appear blank due to the region not having relevant data for these reports. Please provide a cover page to the DB22 report appendix indicating the reason for these report contents being blank. *[Contract Exhibit C, Section 13.1.2]*
Response: Cover pages will be submitted indicating reason for any blank reports.

17. Please remove use of the TWDB logo from the final, adopted regional water plan. In accordance with TWDB's Logo and Seal Policy, use of the TWDB logo requires an approved licensing agreement.
Response: TWDB logo will be removed and not included in final plan.

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Section 3.4, page 3-18. The text cites Table 3-4 as the citation for the summary of MAGs and associated model runs/date of runs; however, Table 3-4 does not exist, and Table 3.4 includes information on livestock surface water supplies. Please consider reconciling this in the final plan.
Response: Thank you for noting this typographical error. The text citation will be corrected to read Table 3-**6.**

2. Chapter 3. To assist with TWDB's review of surface water data, please consider describing the methodology used to derive the 2070 projected reservoir elevation-area-capacity rating curves for Choke Canyon Reservoir and for Lake Corpus Christi.
Response: The projected future capacity is based on sedimentation rates from the TWDB volumetric survey and extrapolating to 2070 conditions. Text will be added in Chapter 3 accordingly.

3. Chapter 3. Please consider discussing reuse supplies separately from surface water, as reuse is considered as a distinct water source for the purposes of regional water planning.
Response: The reuse discussion included in Section 3.3 (Page 3-16) of the draft Plan will be moved to separate section according to comment.

4. Chapter 4. The secondary needs analysis is included for WUGs in Appendix A but is not referenced in the body of the plan. Please consider adding a brief discussion of the secondary needs analysis for WUGs in the final plan.
Response: A brief discussion of secondary needs will be added to Chapter 4A referencing the information included in Appendix A.

5. Page 5D.1-11 includes 'rainwater harvesting' and 'reuse' in the list of advance water conservation measures. While the TWDB acknowledges that the municipal conservation best practices guide includes rainwater harvesting and reuse, for regional water planning purposes these practices are considered separate sources and should not be classified as 'conservation.' Please consider clarifying this information within Section 5D.1.2 in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.6]*
Response: A brief sentence will be added to Section 5D.1.2 to read: While the municipal conservation best practices guide includes rainwater harvesting and reuse, for regional water planning purposes these practices are considered separate sources and not classified as 'conservation.'

6. Section 5D.5.1, page 5D.5-3, states that "according to USACE studies, pulsed flow at certain times of the year are more beneficial than small pass-throughs in dry months." Please consider other recent studies which indicate that small, continuous flows throughout the year improve ecological stability (Montagna, P.A., L. Adams, C. Chaloupka, E. DelRosario, R.D. Kalke, and E.L. Turner. 2016. Determining Optimal Pumped Flows to Nueces Delta. Final Report to the Texas Water Development Board,

Contract # 1548311787. Harte Research Institute, Texas A&M University-Corpus Christi, Corpus Christi, Texas, 75 p.).
Response: The 5D.5.1 will be updated to include this reference and information.

7. Chapter 5, pages 5D.8-36-37; 5D.9-3; and 5D.9-14. Please consider revising the outdated term 'Managed Available Groundwater' to the current term 'Modeled Available Groundwater' in the final, adopted regional water plan.
   Response: Text that states 'Managed Available Groundwater will be replaced with 'Modeled Available Groundwater'.

8. The GIS files submitted for WMS projects do not adhere to the contractually required naming convention. Please rename the GIS files following the naming convention outlined in Exhibit D, Section 2.4.5 in the final GIS files submitted. *[Contract Exhibit D, Section 2.4.5]*
   Response: GIS files will be verified for conformance with Section 2.4.5 prior to submittal of final plan.

Texas Parks and Wildlife comments (letter dated 8/7/2020)

TEXAS
PARKS &
WILDLIFE

Life's better outside.

August 7, 2020

Rocky Freund
Administrative Agent for Region N
Nueces River Authority
400 Mann Street
Corpus Christi, Texas 78401

Re: 2021 Coastal Bend Region N Initially Prepared Plan

Dear Ms. Freund:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department (TPWD) on the 2021 Initially Prepared Regional Water Plan (IPP) for the Coastal Bend Region N Water Planning Area. Thank you for the Region's responsiveness to TPWD's comments in previous planning cycles. Water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. Although TPWD has limited regulatory authority over the use of state waters, we are the agency charged with primary responsibility for protecting the state's fish and wildlife resources. To that end, TPWD offers these comments intended to help avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- Does the IPP address concerns raised by TPWD in connection with the 2010 Water Plan?

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The population of the 11 county Coastal Bend Region is estimated to grow from about approximately 600,000 in 2020 to about 744,544 by 2070. Water needs are expected to increase by 47.2 percent from 187,788 acre-feet in 2010 to 276,492 acre-feet in 2070. Water conservation, the most environmentally benign water management strategy, is a recommended Water Management Strategy (WMS) for all water user groups with needs identified for the planning period. Other proposed WMS include reuse, groundwater pumping, aquifer storage and recovery, brackish groundwater and seawater desalination, voluntary redistribution of surplus water and increased contracts, and improvements to the O.N. Stevens water treatment plant.

The IPP is a well written document. Natural resources are briefly described in Chapter 1.5 and threats to natural resources are discussed in Chapter 1.7. Water quality concerns in the Coastal Bend Region are listed in Table 1.2. The Laguna Madre (Segment ID 2491) is listed for low dissolved oxygen, chlorophyll-a, and nitrates. According to the 2012 303(d) list, this designation is specific to areas 'adjacent to the Arroyo Colorado confluence', which is outside the Region's boundary established in Figure 1.1. The Arroyo Colorado confluence is located in Willacy County. Section 1.12 of the IPP discusses threats to natural resources of the region due to water management strategies and how those threats are addressed by the plan. Please note there have been recent updates (March 30, 2020) to the list of federal and state listed species and Species of Greatest Conservation need, including species in Region N counties. We recommend that you update Table 1.4 with the latest information that is available at:
https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/.

According to the IPP, there are no major springs in the Coastal Bend Region, but there are 18 small springs. In addition, groundwater depletion was identified as a threat to agricultural and natural resources. TWDB planning rules now require that groundwater supplies not exceed the Modeled Available Groundwater (MAG) values that were determined to meet the desired future conditions (DFCs) of the groundwater source. However, DFCs adopted in 2017 for aquifers in the Coastal Bend Region, presented in Table 3.5, do not address protection of springs or groundwater-surface water interaction. TPWD agrees with the statements made in Chapter 6 in which the Coastal Bend Region recognizes the importance of considering groundwater and surface water interaction when managing water resources and evaluating development of future water supplies. In addition, the Region encourages groundwater conservation districts and groundwater management areas to consider protection of springs and groundwater-surface water interaction during when considering new DFCs.

Each water management strategy is evaluated with respect to environmental considerations in Chapter 5. The Summary Comment section for each strategy evaluation (Environmental Factors) are in the form of qualitative ranking (e.g. None, Some, Low, etc.) although each strategy has a more complete 'Environmental Issues' subsection which lists the quantitative aspects of the proposed strategies. Table 5B.1.4 include keys to the environmental factors. Table 6.3 Drought Management was not recommended as a WMS because, according to the IPP, it could not be demonstrated to be economically feasible.

The Coastal Bend Region is to be commended for its emphasis on water conservation and reuse. According to the IPP, per capita water use in Region N is projected to decline over the planning period from 171 gallons per capita daily (gpcd) in 2011 to 153 gallons per person per day in 2070. Municipal water user groups with per capita rates exceeding 140 gpcd were recommended to reduce per capita consumption by 1 percent annually through 2070 until the Texas Water Conservation Task Force goal of 140 gpcd rate is attained.

Seawater and brackish groundwater desalination can be ecologically advantageous strategies, as long as issues such as impingement and entrainment at intake locations and brine disposal options are carefully considered. The IPP addresses environmental issues associated with these strategies, especially the 'brine' disposal and its effects on surrounding habitats. Continued consultation with TPWD staff will help to ensure that fish and wildlife impacts can be avoided or minimized. TPWD notes the Chapter 8 legislative recommendation directing TCEQ to work with TWDB and TPWD to develop information on the potential environmental impacts of concentrate discharges from seawater desalination facilities and to facilitate the permitting of these discharges into tidal waters where site specific information shows that minimal environment damage would occur. As you may be aware, HB 2031 passed by the 84th legislature directed TPWD and the General Land Office to identify zones in the Gulf of Mexico appropriate for the diversion of marine seawater for desalination and for discharge of brine concentrate.

The Region N IPP does not recommend nomination of any stream segments as ecologically unique. TPWD has identified several stream segments in the region that meet at least one of the criteria for classification as ecologically unique should the regional planning group decide to pursue nomination of an ecologically significant stream in the future.

Thank you for your consideration of these comments. TPWD looks forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact me at (512) 389-8715 or Cindy.Loeffler@TPWD.Texas.gov if you have any questions or comments.

Sincerely,

Cindy Loeffler

Cindy Loeffler, Chief
Water Resources Branch

CC: James Tolan, Coastal Fisheries Division

***Response*-**
Texas Parks & Wildlife comments

Response: Thank you for your comments on the 2021 Coastal Bend Region N Initially Prepared Plan. The water quality concerns for Laguna Madre (Segment ID 2491) are located in Willacy County, as correctly mentioned in your letter, and will be removed from Table 1.2. Thank you for mentioning the recent update to the federal and state listed species list (March 30, 2020) since submittal of the 2021 Initially Prepared Plan. Table 1.4 will be updated to reflect this new information with citation updated.
The Legislative and Regional Policy Recommendations for Desalination (Chapter 8.1.3) has been updated to reference the TPWD and GLO study developed for the 84th legislature, as discussed in your comment letter. Thank you for your comments and participating in the regional water planning process.

Texas State Soil and Water Conservation Board (received 6/18/2020)

TEXAS STATE SOIL AND WATER CONSERVATION BOARD
Protecting and Enhancing Natural Resources for Tomorrow

June 18, 2020

Ms. Carola Serrato
Mr. Scotty Bledsoe
Region N Co-Chairs

Dear Region N Co-Chairs;

For the past 2 years the Texas State Soil and Water Conservation Board (TSSWCB) has been participating in the Texas Water Development Board's (TWDB) Regional Water Planning meetings as directed by Senate Bill 1511, passed in the 2017 legislative session. We appreciate being included in the process and offer these constructive comments to the regional water plans and ultimately the State water plan. Attached you will find some specific comments to the Region N water plan as they pertain to the TSSWCB.

As you may know 82% of Texas' land area is privately-owned and are working lands, involved in agricultural, timber, and wildlife operations. These lands are important as they provide substantial economic, environmental, and recreational resources that benefit both the landowners and public. They also provide ecosystem services that we all rely on for everyday necessities, such as air and water quality, carbon sequestration, and wildlife habitat.

With that said, these working lands are where the vast majority of our rain falls and ultimately supply the water for all of our needs, such as municipal, industrial, wildlife, and agricultural to name a few. Texas' private working lands are a valuable resource for all Texans.

Over the years, the private landowners of these working lands have been good stewards of their property. In an indirect way they have been assisting the 16 TWDB's Regional Water Planning Groups in achieving their goals through voluntary incentive-based land conservation practices.

It has been proven over time if a raindrop is controlled where it hits the ground there can be a benefit to both water quality and water quantity. Private landowners have been providing benefits to our water resources by implementing Best Management Practices (BMP) that slow water runoff and provide for soil stabilization, which also slows the sedimentation of our reservoirs and allows for more water infiltration into our aquifers.

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http://www.tsswcb.texas.gov

Some common BMPs include brush management, prescribed grazing, fencing, grade stabilization, irrigation land leveling, terrace, contour farming, cover crop, residue and tillage management, and riparian herbaceous cover.

The TSSWCB has been active with agricultural producers since 1939 as the lead agency for planning, implementing, and managing coordinated natural resource conservation programs for preventing and abating agricultural and sivicultural nonpoint sources of water pollution.

The TSSWCB also works to ensure that the State's network of over 2,000 flood control dams are protecting lives and property by providing operation, maintenance, and structural repair grants to local government sponsors.

The TSSWCB successfully delivers technical and financial assistance to private landowners of Texas through Texas' 216 local Soil and Water Conservation Districts (SWCD) which are led by 1,080 locally elected district directors who are active in agriculture. Through the TSSWCB Water Quality Management Plan Program (WQMP), farmers, ranchers, and silviculturalists receive technical and financial assistance to voluntarily conserve and protect our natural resources. Participants receive assistance with conservation practices, BMPs, that address water quality, water quantity, and soil erosion while promoting the productivity of agricultural lands. This efficient locally led conservation delivery system ensures that those most affected by conservation programs can make decisions on how and what programs will be implemented voluntarily on their private lands.

Over time. lands change ownership and many larger tracts are broken up into smaller parcels. Most new landowners did not grow up on working lands and therefore may not have a knowledge of land management techniques. The TSSWCB is writing new WQMPs for these new landowners who are implementing BMPs on their land. Education and implementation of proper land management and BMPs continues to be essential. Voluntary incentive-based programs are essential to continue to address soil and water conservation in Texas.

These BMPs implemented for soil and water conservation provide benefits not only to the landowner but ultimately to all Texans and our water supply.

Respectfully,

Barry Mahler
Chairman

Rex Isom
Executive Director

Attachment

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http://www.tsswcb.texas.gov

Region N (Coastal Bend)

- Acknowledgements, Non-Voting Members
    - Include Texas State Soil and Water Conservation Board (TSSWCB), Rusty Ray
- Page 3, Table ES.1. Coastal Bend RWPG Members (as of January 2020)
    - Include Texas State Soil and Water Conservation Board (TSSWCB), Rusty Ray

***Response*-**
Texas State Soil and Water Conservation Board (TSSWCB) comments

Response: Thank you for your comments on the 2021 Coastal Bend Region N Initially Prepared Plan. We appreciate the work that TSSWCB does to support agricultural producers and natural resource conservation programs, including providing technical and financial assistance to private landowners. Region N is pleased to hear about the new TSSWCB Water Quality Management Plan Program (WQMPs) for implementing BMPs on private land. While land management practices through brush control are not included as water management strategies in the plan, we recognize the interest of these practices to land managers. We welcome you to reach out to the Nueces River Authority if the TSSWCB desires to present information on your new WQMPP to the Region N RWPG. Thank you for your comments and participating in the regional water planning process.

Public Comments-
Legislative and Policy

Shaw, Kristi

From:	Donna Rosson <drossonjr@yahoo.com>
Sent:	Sunday, February 16, 2020 10:02 AM
To:	Shaw, Kristi
Cc:	John Byrum
Subject:	Suggested Edits to Water Plan
Attachments:	Edits Water Development Plan Sec#1_DR.docx; Water Development Plan Sec. 8 RE Desalination Legislation Recommendations 2-8-2020 Draft #1(1).docx

Kristi,
I have attached two documents for review. One is a rather extensive review of the 2021 Water Plan containing comments that I believe should be shared at the state level. The commentator is a retired environmental attorney who worked for the City of Corpus and shines light on some concerns that the municipalities, counties, and the State of Texas should consider. These will be of special concern to the public in the future as costs for water increases and our local natural resources are damaged or depleted.

The second document contains language that I would like included in the 2021 Water Plan. It is less wordy than the original but has some items that I believe the CBRWPG should be considering as we delve into the upcoming desalination projects. I've been told by other board members that our 'job' is not to evaluate a project but approve them as consistent with the Water Plan so I wnet back to the mission of the TWDB:

The mission of the Texas Water Development Board (TWDB) is ***to provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas****. Our mission is a vital part of Texas' overall vision and the state's mission and goals that relate to maintaining the viability of the state's natural resources, health, and economic development.*

Maybe we need to read this at the beginning of each meeting? Responsible development of water seems to point to the idea that we do indeed need to consider impacts of these projects to surrounding waters and not just if they align with the plan in general. My thoughts.

I will not be able to attend the upcoming meeting because of long held travel plans but hope these edits are carefully considered by the Board.

Thank you,
Donna Rosson

Note: Author's original draft has Roman numerals out of order. IV is missing.

8.1.2 Interbasin Transfers

I. The Texas Legislature is urged to repeal the "Junior Rights" provision and the additional application requirements for interbasin transfers that were included in Senate Bill 1.

8.1.3 Desalination

I.. The Texas Legislature is urged to direct TCEQ to investigate the current regulatory status of the "concentrate" or "reject water" produced during the desalination of brackish ground water, brackish surface water and seawater in industrial and municipal treatment processes and compare these to reject water requirements for the oil and gas industry. No common set of standards for the disposal of these waste products is possible for reason that brine concentrate disposal into tidal areas anticipates waste disposal into jurisdictional Waters of the United States of America. This action holds portent for federal intervention and/or preemption. Therefore, deep well injection or disposal far off-shore for such brine waste should be given priority consideration in order to avoid jurisdictional conflicts with federal interests. Separate disposal standards should be anticipated for disposal into federal waters in contrast to disposal standards for inland surface and ground waters where TCEQ has purview. Avoidance of jurisdictional conflict is imperative so that safe, economical and litigation free methods of disposal will be available to encourage the application of these technologies in Texas.

II. The Texas Legislature is urged to direct TCEQ to work with USFWS (United States Fish and Wildlife Service, USACOE (United States Army Corps of Engineers), and National Marine Fisheries Services. TWDB and TPWD to develop information on the potential environmental impacts of concentrate discharges from seawater desalination facilities and to facilitate the permitting of these discharges into tidal waters where site specific information shows that minimal environment damage would occur. Assuming even minimal environmental damage, the Corps and US Fish, Wildlife Service, and National Marine Fisheries Services should be consulted as priority agency stakeholders. There should be competent legal review of the federal interest, to understand the prevailing salinity, chemistry, and physical properties of receiving jurisdictional waters of the United States.

III. Texas Legislature is urged to amend state laws governing the procurement of professional services by public agencies in order to allow municipalities, water districts, river authorities, smaller communities, and other public entities, provided that they have the expertise, to utilize alternative delivery methods for public work projects, including desalination facilities. For example, some large-scale desalination facilities are now constructed using CMAR (Construction-Management-at-Risk) or Public Private Partnership methods, allowing for a cost-effective transfer of project risks to the private sector. Special attention should be paid to Texas case law [City of Corpus Christi v. Bayfront Associates, Ltd., 814 S.W.2d 98 (Tex. App. 1991)] holding that the state's constitution precludes enforcement of traditional legal partnership agreements between Texas municipalities and third parties.

V. The Texas Legislature is urged to support evaluation, construction and implementation of a pilot desalination plant to quantify and qualify impacts of operating a brackish or seawater desalination facility in the Coastal Bend Region. Avoidance of some conflicts may be ensured by planning and performing disposal of concentrated brine wastes in deep wells or far off-shore. Those prudent disposal options should be anticipated costs among the Legislature's support options. In contrast, a pilot project using brackish ground water holds fewer risks, provided concentrate disposal is deep well or far off shore.

VI. An evaluation should be undertaken of the feasibility of a regional desalination facility for the treatment of poor quality groundwater or seawater to improve the quality of potable water to these cities. In this regard, groundwater is the better candidate for reasons of federal interference. Groundwater enjoys the protective mantle of the State of Texas against federal encroachment. The Legislature's goal would be to avoid federal claims where disposal and takings are concerned. Therefore, operators should be helped to use the deep well or far-off-shore disposal options, rather than risk impairing Waters of the United States as receptacles for waste concentrate. Texas Legislative support for desalination should emphasize wiser assist to groundwater improvement because there is no federal interest in that asset.

VII. Studies of desalination options to further reduce the cost of using seawater and/or brackish groundwater should be continued. Cost considerations should be given high priority. Costs of using seawater and/or brackish groundwater do not end when facilities are completed and production is underway. True social overhead costs for the Texas Legislature to consider like those from brine disposal, include, but are not limited to, environmental damages. The Texas Legislature should consider that heavy industrial use of water, however it may be sourced, whether from a bay or a well, is anathema to economic diversification unless careful stewardship is applied. Stewardship plans, to ensure and preserve economic diversification, should be included among the Legislature's support options.

Note: Author's original draft has Roman numerals out of order. IV is missing.

8.1.2 Interbasin Transfers

I. The Texas Legislature is urged to repeal the "Junior Rights" provision and the additional application requirements for interbasin transfers that were included in Senate Bill 1.

8.1.3 Desalination

I.I. The Texas Legislature is urged to direct TCEQ to investigate the current regulatory status of the "concentrate" or "reject water" produced during the desalination of brackish ground water, brackish surface water and seawater in industrial and municipal treatment processes and compare these to reject water requirements for the oil and gas industry. No and arrive at a common set of standards for the disposal of these waste products is possible for reason that brine concentrate disposal into tidal areas anticipates waste disposal into jurisdictional Waters of the United States of America. This action holds portent for federal intervention and/or preemption. Therefore, deep well injection or disposal far off-shore for such brine waste should be given priority consideration in order to avoid jurisdictional conflicts with federal interests. Separate disposal standards should be anticipated for disposal into federal waters in contrast to disposal standards for inland surface and ground waters where TCEQ has purview. Avoidance of jurisdictional conflict is imperative so that safe, economical and litigation free methods of disposal will be available to encourage the application of these technologies in Texas. Adjustments in marine water salinity, as well as chemistry, temperature, and physical changes, affecting Waters of the United States pose risk of federal assertion. One such example of risk lies with obligations owed to the US Bureau of Reclamation for fresh water releases into Waters of the United States of America attendant construction and federal permitting of the Wesley Seale Dam complex and predicated upon maintenance and regulation of salinity levels in receiving federal waters. A local oversight Council exists to assist this purpose by virtue of federal designation to TCEQ, a designation that might be withdrawn if challenged by either an agency or citizen's suit that proves failure to meet the federal standard.

II. The Texas Legislature is urged to direct TCEQ to work with USFWS (United States Fish and Wildlife Service, USACOE (United States Army Corps of Engineers), TWDB and TPWD to develop information on the potential environmental impacts of concentrate discharges from seawater desalination facilities and to facilitate the permitting of these discharges into tidal waters where site specific information shows that minimal environment damage would occur. Assuming even minimal environmental damage, the Corps and US Fish and Wildlife Service should be consulted as priority agency stakeholders. The reason is that minimal environmental damage within the purview of the TCEQ is not synonymous with de minimis impact within the federal regulatory scheme. The City of Corpus Christi and other proposed desalination sites are perched adjacent Waters of the United States of America, federal jurisdictional waters. Therefore, there should be competent legal review of the federal interest, to understand the prevailing salinity, chemistry, and physical properties of receiving jurisdictional waters of the United States. This review may point to need for new federal rule making, rule amendments, or application for federal waste disposal permits to accommodate the several proposed Coastal Bend desalination plants. Issue briefing is important because the federal interest is not limited merely to salinity levels, but includes consequential changes in the physical properties of federal waters and the wildlife that abides therein or is dependent in migration (Migratory Bird Treaty Act). Most important for Legislative awareness, projection of the federal interest, within its own jurisdictional waters, does not require the federal government to plead the Endangered Species Act. For that reason, the Texas Legislature should be prepared to assuage federal interests to avoid wasting resources in litigation. That consideration might go to environmental opponents as well. Citizens have litigation standing where agencies lack enforcement resources or policy instructions. This example was recently played out in the Formosa Chemicals litigation and record settlement agreement. Texas Legislative strategy should also plan for potential changes in federal administrations that may redefine or refocus EPA priorities and Department of Justice enforcement targets. Environmental policy changes, even existing policy, could treat daily process of millions of gallons of jurisdictional seawater to be consumption of a compensable federal resource, used to produce millions of gallons of desalinated water for sale in daily commerce. The Texas Legislature should plan to incur preventive costs to avoid such federal compensation issues. Desalination plant operators, who hold Texas permits, might similarly plan for risk reduction or risk transfer, through insurance or otherwise, should their operations be held to owe compensation to the United States, or to be operating illegally without a federal takings permit. The Texas Legislature should take steps to protect state and local taxpayers from having this risk shifted to them.

III. Texas Legislature is urged to amend state laws governing the procurement of professional services by public agencies in order to allow municipalities, water districts, river authorities, smaller communities, and other public entities, provided that they have the expertise, to utilize alternative delivery methods for public work projects, including desalination facilities. For example, some large-scale desalination facilities are now constructed using CMAR (Construction-Management-at-Risk) or Public Private Partnership methods, allowing for a cost-effective transfer of project risks to the private sector.1 Special attention should be paid to Texas case law [City of Corpus Christi v. Bayfront Associates, Ltd., 814 S.W.2d 98 (Tex. App. 1991)] holding that the state's constitution precludes enforcement of traditional legal partnership agreements between Texas municipalities and third parties.

V. The Texas Legislature is urged to support evaluation, construction and implementation of a pilot desalination plant to quantify and qualify impacts of operating a brackish or seawater desalination facility in the Coastal Bend Region. In pursuing this pilot project, the Legislature should take care to avoid conflicts arising from federal preemption where brine waste disposal into Waters of the United States may be contemplated or occur by accident. This issue is discussed above and includes interests broader than those of the Endangered Species Act. The same holds for marine water taken for process that may be regarded as compensable to the United States. Avoidance of some conflicts may be ensured by planning and performing disposal of concentrated brine wastes in deep wells or far off-shore. Those prudent disposal options should be anticipated costs among the Legislature's support options. Prudent disposal, however, does not resolve the prospect of a future takings claim from the federal government against those engaged in consuming the millions of gallons of federal sea water necessary on a daily basis for a pilot project. Federal agency consultation predicate to a special, pilot-takings permit may be in order, conditioned upon a federal de minimis outcome. In contrast, a pilot project using brackish ground water holds fewer risks, provided concentrate disposal is deep well or far off shore.

VI. An evaluation should be undertaken of the feasibility of a regional desalination facility for the treatment of poor quality groundwater or seawater to improve the quality of potable water to these cities. In this regard, groundwater is the better candidate for reasons of federal interference. Groundwater enjoys the protective mantle of the State of Texas against federal encroachment. The Legislature's goal would be to avoid federal claims where disposal and takings are concerned.

Therefore, operators should be helped to use the -deep well or far-off-shore disposal options, rather than risk impairing Waters of the United States as receptacles for waste concentrate. These advantageous disposal moves apply to both processed ground water and processed marine water. If seawater is consumed for process, the Legislature should also consider potential for a federal takings claim against those consuming federally protected waters as discussed above. Improvement of ground water, on the other hand, so long as brine concentrate is deep well or far off shore disposed, does not pose a federal takings issue. In short, groundwater improvement might be the better candidate for desalination investment, as it does not hold the many federal issues that attend marine water use. While current EPA policy, under an administration that promotes deregulation, is a favorable atmosphere for desalination projects, the Legislature should consider that the federal government is not likely to back off environmental rules that also prevent large marine vessels from pumping bilge waste into Corpus Christi and other port bays throughout the nation. With that in mind, it is unlikely an administration would /could sustain a move to disregard a body of law for federal water protections. That disregard might, in the short term, allow a closed bay system to be systematically salted to levels federal interests or citizens' suits might later claim to be adverse to marine and migratory wildlife. Increased salinity levels are the more likely when process needs also include extracting millions of gallons of sea water daily, particularly within a closed circulatory system. A favorable environmental assessment by the TCEQ will not be a defense should a future federal administration, or citizen's suit, treat desalination outcomes as detrimental to the federal interest within jurisdictional waters, triggering enforcement. Therefore, Texas Legislative support for desalination should emphasize wiser assist to groundwater improvement because there is no federal interest in that asset. Absence of such federal interest is evidenced by regulatory conditions that surround local aquifers like the Edwards Aquifer and its recharge zones. Interferences with private property rights in the case of the Edwards are predicated solely upon Endangered Species, allowing for modest enforcement options assumed by the State and local governments dependent on the Edwards' groundwater.

VII. Studies of desalination options to further reduce the cost of using seawater and/or brackish groundwater should be continued. Cost considerations should be given high priority. Costs of using seawater and/or brackish groundwater do not end when facilities are completed and production is underway. Costs and benefits

must be weighed to avoid fatal flaw. Fail-safe disposal costs for concentrated brine waste tend to be high; thus, early projects have been envisioned that tend to minimize or avoid embracing disposal costs by assuming tidal area disposal has no cost and little impact, an assumption could bring the Texas Legislature and plant proponents to a disappointing end. This could be the fatal flaw because the assumption has no basis in reality or in federal law. The tidal areas in question are federal jurisdictional waters. The tidal areas, proposed for concentrate disposal, sit inside the barrier islands as fragile, closed nursery grounds, segregated from the open Gulf of Mexico. Within those federal waters, Texas must avoid creating dead zones from toxic effluent similar to those in Africa and the Middle East that have resulted from Saudi Arabian brine disposal.
https://www.bloomberg.com/news/articles/2019-01-08/saudi-thirst-for-water-is-seen-creating-a-toxic-brine-problem These are examples, certain to trigger federal interference, that the Texas Legislature should guard against. True social overhead costs for the Texas Legislature to consider like those from brine disposal, include, but are not limited to, environmental damages. There are other opportunity costs to be paid for heavy industrial development, promotion that now seeks multiple desalination plants in the Coastal Bend. Those opportunity costs prevent a community's further economic diversification toward wildlife preservation and recreational enterprise. Economic diversification has always been high on the Legislature's priority list. So, the Texas Legislature should consider that heavy industrial use of water, however it may be sourced, whether from a bay or a well, is anathema to economic diversification unless careful stewardship is applied. Stewardship plans, to ensure and preserve economic diversification, should be included among the Legislature's support options.

***Response*-**
Legislative and Policy Recommendations

Response: The Region N legislative and policy subcommittee met virtually on July 23, 2020 in an open meeting to consider the comments provided by Ms. Rosson and Ms. Ferris. Region N adopted the subcommittee's recommendation and subsequently, text was revised in Chapter 8.1.3 accordingly.

Public Comments-
City of Three Rivers water right

April 21, 2020

Status of Three Rivers Water Supply

While reviewing the draft of the Region N Planning document for 2020 , I noted what appears to be an error as to Three Rivers 's water supply. The draft appears to not recognize the December 3, 1984 Contract between the City of Corpus Christi and the City of Three Rivers. That contract involved the sale of 2 % of Choke Canyon and its yield to Three Rivers in exchange for payment of $1,750,000. In addition, Three Rivers received up to 3,000,000 gallons of water daily at no cost and an additional up to 2,000,000 gallons per day at cost as defined in the contract. Three Rivers became obligated to pay its share of the cost of maintaining Choke Canyon Reservoir. In exchange Three Rivers gave up its right to construct a 1900 acre foot reservoir, retaining only the right to certain river access locations.

The date of the contact and its execution by all of the appropriate public officials in 1984 would appear to support the conclusion that the Planning Document being prepared should indicate Choke Canyon has 3 owners and its permit should be increased in the report by 1500 acre feet or the amount of water rights related to Certificate of Adjudication No. 21-3215.

Appropriate changes are indicated on pages 3-8, and 5-45, and at any other location impacted by this change.

The Contract attempts to exclude the first 750,000 gallons each day from Corpus Christi's conservation or drought management plan. I assume that submission of Corpus Christi's Drought plan to the State for approval probably strikes this section.

A section of the Contract requires Corpus Christi to operate wells to serve Three Rivers during periods of extreme drought. This section was probably revised when Corpus Christi approved Three Rivers locating its intake in Choke Canyon's Lake.

Section13 of the Contract makes Corpus Christi responsible to obtain any required State approvals. I assume such actions were completed.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

DOCKET NO. 95-0616-WR

IN RE: AGREED ORDER ESTABLISHING OPERATIONAL PROCEDURES PERTAINING TO SPECIAL CONDITION 5.B., CERTIFICATE OF ADJUDICATION NO. 21-3214, HELD BY THE CITY OF CORPUS CHRISTI, NUECES RIVER AUTHORITY, AND THE CITY OF THREE RIVERS	§ § § § § § § § §	BEFORE THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

AN AGREED ORDER amending the operational procedures and continuing an Advisory Council pertaining to Special Condition 5.B., Certificate of Adjudication No. 21-3214

On April 26, 1995, came to be considered before the Texas Natural Resource Conservation Commission ("Commission") the Motion by the City of Corpus Christi for the adoption of an Agreed Order establishing operating procedures pertaining to Special Condition 5.B., Certificate of Adjudication No. 21-3214, held by the City of Corpus Christi, the Nueces River Authority, and the City of Three Rivers" (the two cities and river authority shall be referred to herein as "Certificate Holders").

After hearing and considering the proposed operational procedures and the presentations of the parties, the Commission finds that it has authority to establish operational procedures under Special Condition 5.B. of Certificate of Adjudication No. 21-3214, and that operational procedures previously established should be amended. The Commission finds that, because of the need to continue to monitor the ecological environment and health of related living marine

Table 3.1.
Nueces River Basin Water Rights in the Coastal Bend Region

Water Right No.	Name	Annual Diversion Volume (ac-ft/yr)	Reservoir Storage Capacity (ac-ft)	Priority Date	Type of Use	Facility	County
2464	City of Corpus Christi	304,898	301,175	12/1913[1]	Municipal (51%) Industrial (49%) Irrigation (minimal) Mining (minimal)	Lake Corpus Christi (300,000 ac-ft) and Calallen Dam (1,175 ac-ft)	Nueces
2465A	Realty Traders & Exchange, Inc.	20	580	10/1952	Irrigation		San Patricio
2465B	Wayne Shambo	140	580	10/1952	Irrigation		San Patricio
2466	Nueces Co. WCID #3	11,546	0	2/1909[1]	Municipal (37%) Irrigation (63%)		Nueces
2467	Garnett T. & Patsy A. Brooks	221	0	2/1964	Irrigation		San Patricio
2468	CE Coleman Estate	27	0	2/1964	Irrigation		Nueces
2469	Ila M. Noakes Lindgreen	101	0	2/1964	Irrigation		Nueces
3141	Randy J. Corporron, et al.	8	0	12/1965	Irrigation		McMullen
3142	WL Flowers Machine & Welding Co.	132	100	12/1958	Irrigation		McMullen
3143	Ted W. True, et al.	220	40	12/1958	Irrigation		McMullen
3144	Harold W. Nix, et ux.	0	285	2/1969	Recreation		McMullen
3204	Richard P. Horton	233	0	12/1963	Irrigation		McMullen
3205	Richard P. Horton	103	122	12/1963	Irrigation		McMullen
3206	James L. House Trust	123	0	12/1966	Irrigation		McMullen
3214	Nueces River Authority and City of Corpus Christi	139,000	700,000	7/1976	Municipal (43%) Industrial (57%) Irrigation (minimal)	Choke Canyon Reservoir	Nueces/ Live Oak
3215	City of Three Rivers	1,500	2,500	9/1914	Municipal (47%) Irrigation (53%)		Live Oak
4402	City of Taft	600	0	9/1983	Irrigation		San Patricio
5065	Diamond Shamrock Refining[2]	0	0	6/1986	Irrigation		Live Oak
5145	San Miguel Electric Co-Op, Inc.	300	335	12/1990	Industrial		McMullen
5736	City of Corpus Christi	8,000		9/2001	Wetlands		San Patricio
	TOTAL	**467,172**					

[1] Water right with multiple priority dates. Earliest date shown in table.

[2] Diamond Shamrock irrigation right is used for irrigation from onsite process water return flows. In effect, this permit is for a reuse project.

5B.9.3 McCoy WSC

McCoy WSC's demands are met with groundwater from the Carrizo-Wilcox Aquifer. No shortages are projected for McCoy WSC and no changes in water supply are recommended.

5B.9.4 City of Three Rivers

The City of Three Rivers' demands are met with surface water rights on the Nueces River. No shortages are projected for Three Rivers; however, additional water conservation is a recommended water management strategy for the City (Table 5B.9.6).

Table 5B.9.6.
Recommended Water Supply Plan for the City of Three Rivers

	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	0	37	24	18	17	17
New Balance	**0**	**37**	**24**	**18**	**17**	**17**

Estimated costs of the recommended plan for the City of Three Rivers are shown in Table 5B.9.7.

Table 5B.9.7.
Recommended Plan Costs by Decade for the City of Three Rivers

Plan Element	2020	2030	2040	2050	2060	2070
Municipal Water Conservation (Chapter 5D.1)						
Annual Cost ($/yr)	$0	$18,399	$12,165	$9,165	$8,665	$8,665
Unit Cost ($/ac-ft)*	$500	$500	$500	$500	$500	$500

* Unit costs for this plan element are rounded.

5B.9.5 County-Other

Live Oak County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Live Oak County-Other and no changes in water supply are recommended.

5B.9.6 Manufacturing

Live Oak County manufacturing users receive groundwater supplies from the Gulf Coast Aquifer and surface water supplies from run-of-river rights in the Nueces Basin. Shortages are projected for Live Oak Manufacturing beginning in 2030. The recommended water supply management plan is shown in Table 5B.9.8.

***Response*- City of Three Rivers water right**

Response: According to TCEQ, Water Right No. 21-3215 still shows the City of Three Rivers as the water right holder. Table 3.1 was updated as follows, with concurrence from Mr. Townsend.

Table 3.1.
Nueces River Basin Water Rights in the Coastal Bend Region

Water Right No.	Name	Annual Diversion Volume (ac-ft/yr)	Reservoir Storage Capacity (ac-ft)	Priority Date	Type of Use	Facility	County
2464	City of Corpus Christi	304,898	301,175	12/1913[1]	Municipal (51%) Industrial (49%) Irrigation (minimal) Mining (minimal)	Lake Corpus Christi (300,000 ac-ft) and Calallen Dam (1,175 ac-ft)	Nueces
2465A	Realty Traders & Exchange, Inc.	20	580	10/1952	Irrigation		San Patricio
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3141	Randy J. Corporron, et al.	8	0	12/1965	Irrigation		McMullen
3142	WL Flowers Machine & Welding Co.	132	100	12/1958	Irrigation		McMullen
3143	Ted W. True, et al.	220	40	12/1958	Irrigation		McMullen
3144	Harold W. Nix, et ux.	0	285	2/1969	Recreation		McMullen
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3205	Richard P. Horton	103	122	12/1963	Irrigation		McMullen
3206	James L. House Trust	123	0	12/1966	Irrigation		McMullen
3214	Nueces River Authority, City of Corpus Christi, and City of Three Rivers[2]	139,000[2]	700,000	7/1976	Municipal (43%) Industrial (57%) Irrigation (minimal)	Choke Canyon Reservoir	Nueces/ Live Oak
3215	City of Three Rivers[2]	1,500[2]	2,500	9/1914	Municipal (47%) Irrigation (53%)		Live Oak
4402	City of Taft	600	0	9/1983	Irrigation		San Patricio
5065	Diamond Shamrock Refining[3]	0	0	6/1986	Irrigation		Live Oak
5145	San Miguel Electric Co-Op	300	335	12/1990	Industrial		McMullen
5736	City of Corpus Christi	8,000		9/2001	Wetlands		San Patricio
	TOTAL	**467,172**					

[1] Water right with multiple priority dates. Earliest date shown in table.

[2] According to Special Condition 5B Certificate of Adjudication No. 21-3214 (April 26, 1995) and amendment to the 1984 deed and water contract between the City of Three Rivers and the City of Corpus Christi (April 29, 2005), the City of Three Rivers was added to No. 21-3214 with transfer of ownership of 2% of designed storage and firm yield in Choke Canyon in an average amount of 3 MGD. Through this instrument, the City of Three Rivers can directly divert from Choke Canyon Reservoir. In exchange, the City of Three Rivers permanently transferred management, control and coordination responsibility over Water Right No. 21-3215 to the City of Corpus Christi for use in the Frio and Atascosa watersheds. The City of Three Rivers retains water storage rights (No. 21-3215) associated with the current channel dam.

[3] Diamond Shamrock irrigation right is used for irrigation from onsite process water return flows (i.e. reuse project).

Public Comments-

Public Hearing Format

From: Donna Rosson
Sent: Monday, April 13, 2020 5:47 PM
Subject: Re: Region N Regional Water Planning Committee

John,

I agree with Teresa's comments. This format will likely impede the opportunities of the public to comment fully and will restrict access to those who do not have the capability to conference call. Some of the public that I have received comments from object to this format. Since so many State processes have been altered or delayed, can't the deadlines for the Plan be pushed back as well, to allow fair process? This document is too important to possibly exclude some of our interested stakeholders.

Thank you,

Donna Rosson, MPH, MT

On Tuesday, April 7, 2020, 2:57:33 PM CDT, Kevin Smith wrote:

Hi Teresa,

Just wanted to chime in. Gov. Abbott recently issued an order that waived certain requirements of the OMA, please see links below.

https://www.texasattorneygeneral.gov/sites/default/files/images/admin/2020/Press/Open%20Meeting%20Laws%20Subject%20to%20Temporary%20Suspension.pdf

https://gov.texas.gov/news/post/governor-abbott-allows-virtual-and-telephonic-open-meetings-to-maintain-government-transparency

I don't know the legalese either, but my understanding is that the IPP hearing is not a public meeting, so a quorum of the RWPG is not required. IPP hearing requirements are significantly different (more rigorous) from regular meeting requirements, notice of the hearing were posted in local newspapers at least 30 days prior to hearing, mailings were sent to individual water right holders, public water systems, and water districts. IPPs were sent to libraries in each RWPG counties. I know that the local desalination projects are of particular interest to environmental groups, I have suggested that direct notification be sent to these groups as well.

I think the issue with having a hearing in late summer would be that the RWPG couldn't meet its contractual obligation to issue the final RWP by the deadline in October due to comment period requirements after the hearing.

Kevin

From: Teresa Carrillo
Sent: Tuesday, April 7, 2020 2:23 PM
Subject: Re: Region N Regional Water Planning Committee

Hello Carola and Scotty, I hope you're all doing well and staying healthy!

Here are my thoughts about this call - I'm not sure this phone call would suffice as a Public Meeting. I don't know the legalese, but it does seem that a meeting in person would be a requirement.

How would the public be informed of this teleconference and how would they have access to the draft document?

I think we should postpone the date for all the comments to be received, from the June 22nd date to October 31.

While I think the phone call for the public to both listen to experts and to provide input is a good idea, I'm not sure it would meet Public Meeting requirements. I think this should be postponed, and that we should have a real meeting in August or September IF the virus threat has waned by then.

This is my request that we consider this. Thank you for all you have done for Region N.

Teresa Carrillo, Region N Representative for the Environment

On Thu, Apr 2, 2020 at 4:13 PM John Byrum wrote:

Good afternoon Region N Members,

Please see the revised notice attached.

As an FYI, the conference calling system we will be using will handle up to 1000 calls per conference and will be recorded up to 6 hours.

The notice will be sent to the stakeholders list tomorrow.

Please feel free to contact me with any questions or concerns you may have concerning this matter. NRA is working remotely, so my cell is the best way to call during this time of restricted access. My cell number is <Redacted>.

THANKS

John Byrum
Executive Director
200 E. Nopal, Suite 206 Uvalde, TX 78801
P.O. Box 349 Uvalde, TX 78802-0349
www.nueces-ra.org

***Response*-**
Public Hearing Format

Response: The April public hearing was postponed and rescheduled for June 2, 2020 to provide an additional ~6 weeks for public review and comment prior to public hearing.

On Tue, Apr 14, 2020 at 3:44 PM Carola Serrato wrote:

Teresa and Donna,

Today, a conference call was held to discuss your concerns. Kristi, Kevin, John, Scotty and I appreciate your comments. It was decided to postpone the Public Hearing. John will be following up with the details in the next day or so after he makes contact with the Texas Register, the various counties' libraries, the various counties' Clerk's Offices, and the NRA's IT department. We believe, due to the lead time to get a publication into the Texas Register and the required 30-day publication time prior to the Hearing, that the Public Hearing will be sometime in early June – again the details will follow..

It is important to note that the mid-October deadline to provide the final, adopted Plan to the TWDB has not changed.

Meanwhile, John is having a special email address established by the NRA to receive comments on the IPP – since the IPP is already available.

The NRA interested parties list contains about 110 contact names/groups. *But, Teresa and Donna, if there are any groups or individuals that you want to be certain are included, please provide the information to John.*

I hope everyone is doing well. Stay Safe and Take Care.

Carola

Public Comments-
Population Growth

PROJECTED INCREASE IN POPULATION GROWTH BY DECADE
COUNTIES UNDER CITY OF CORPUS CHRISTI WATER MANAGEMENT AUSPICES
(ARANSAS, BEE, JIM WELLS, KLEBERG, LIVE OAK, NUECES, SAN PATRICIO)[i]

Year	Population	10 year increase	10 year % increase
2020	593,095		
2030	638,861	45,766	7.72
2040	668,924	30,063	4.71
2050	688,422	19,498	2.91
2060	705,564	17,142	2.49
2070	717,888	12,324	1.75
50 year growth		124,793	21.04

The average annual population growth over the next 50 years is .421 %.

A more aggressive conservation program could help municipal demand level off or decrease, even with an increase in population. A goal of 1% annual reduction in municipal consumption, which is greater than the 0.421% population growth, would defer the need for additional supplies[ii]. Conservation alone would be sufficient to meet the growth through 2070.

In San Patricio County, 10 MGD of potable water meets the needs of 60,000 residential, commercial, and industrial customers. Industry in San Patricio County used 9 MGD of raw and treated (process) water, about the equivalent of the other 60,000 customers. [iii] That's about the same ratio in the City of Corpus Christi data, showing 52% of their total demand is industrial.[iv]

Even if conservation falls short, an additional freshwater yield of 10 MGD would be sufficient to meet the population growth by 2030, and another 10 MGD by 2040 would satisfy needs until 2070….for the entire seven county region.

10 MGD in the next 10 years is readily achievable without seawater desalination. In addition to conservation efforts, water re-use and reclamation can result in lessening the demand on our current supply. A project being studied in San Patricio County would lessen the industrial demand by 6.7 MGD by re-using effluent for industrial process water.[v] More important, the Evangeline/Laguna segment of the Gulf Coast Aquifer has thousands of acre feet of water available, much of it freshwater that requires only chlorine. The City of Sinton has used it for 25 years.

These are all less expensive and environmentally friendlier strategies than building costly seawater desalination facilities that threaten the bays. The City spent $2.7 m for engineering to study the most expensive and environmentally risky strategy instead of pursuing the alternatives. An educational campaign for conservation would cost a fraction of what they spent on the engineering study for seawater desalination facilities. Groundwater is readily available in as little as 2 years but the City is concentrating on the needs of future petrochemical and other industries that require massive amounts of water.

Is the City "managing" for drought resiliency or industrial growth?

After the drought of 2011, the City proceeded to build the Mary Rhodes Pipeline Phase II. When it was completed in 2016 as a fourth water source from the Colorado River, joining Choke Canyon, Lake Corpus Christi and Lake Texana Mary Rhodes Phase I pipeline, the combined system was hailed by the City as serving the current and future municipal and industrial needs of the region. It would bring an additional 31.2 million gallons per day.

However, as soon as the new water source became available, the City agreed to supply Exxon/SABIC with 20 MGD and promised Steel Dynamics 5 MGD. This new water source that would support growth over the next 50 years was literally drained by these two new facilities, together consuming 80% of this new source.

The City now wants to build seawater desalination facilities. This approach is the most expensive and carries with it the greatest risk to the natural environment. Once again, is this for drought resiliency or industrial growth?

The Corpus Christi Regional Economic Development Corporation, the Port of Corpus Christi, and the City continue to promote chemical and petrochemical expansion. They want to build now because these new industries want assurances the City will supply them with their massive demands for water. One of the many "attraction" projects they are all trying to land here is the mysterious Project *Falcon*, an ethane cracker plastics manufacturing facility larger than Exxon/SABIC. *Falcon* will require upwards of 30 MGD, 75% of the new freshwater yield that would come from the City's desal facility on the La Quinta Channel, a facility that the City says will cost $768,475,000 to build and $114,202,000 a year to operate over the next 20 years.

And, the spike in population growth over the next 10 to 20 years is premised upon those industries locating here. After that, population growth subsides and these new industries will be settled in. After these facilities are built, when the air is not as clean, when the fisheries have been forever damaged, when you see more miles of concrete and steel, when tourists find other more attractive places to go, the growth patterns are probably right on…who wants to live or move here?

Rather than plunge into expensive projects that are environmentally invasive, only to attract other expensive and environmentally invasive industries, you curtail that industrial expansion. You seek other less destructive growth that does not drain our natural resources to the extent these industries do.

In short, the City squandered our new water supply from the Mary Rhodes Pipeline(s). This is not what Mayor Mary Rhodes had in mind. Despite this, we have sufficient supplies and alternatives to meet the demands in time of drought. We do not need seawater desalination that will only be consumed by industry, resulting in no net increase to our supply.

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[i] TWDB, 2021 Regional Water Regional Water Plan

[ii] 2019 Corpus Christi Conservation Plan

[iii] 2019 San Patricio Municipal Water District Conservation Plan

[iv] Ibid, 2019 CC C P

[v] Ibid, 2019 San Pat MWD C P

***Response*-**
Population Growth

Response: Thank you for your comments. The TWDB provided draft population projections in December 2016 based on Texas State data analysis and census information. Region N created a subcommittee, at its Region N meeting on January 19, 2017, to review population projections. The subcommittee held an open meeting on April 6, 2017 to discuss population projections and prepare recommendations for Region N planning group consideration. The recommendations were brought back to the Region N planning group and at its August 10, 2017 meeting with recommended updates adopted by the RWPG sent to the TWDB for consideration. The TWDB adopted such Region N recommendations for use in 2021 Region N Plan development. Since this is the basis of the majority of work associated with regional water planning, these decisions were made (and need to be made) early in the planning process. We anticipate that a similar approach will be followed in future planning cycles, and population projections will be included as agenda item for discussion at associated Region N meetings.

Public Comments-
Desalination

Comments on desalination provided by the following commenters were received and considered (see table included previously in the introduction of agenda item):

- Hamlet Newsom
- Randy Cain
- Emily Nye
- Patrick Nye
- Encarnacion Serna Jr
- Errol Summerlin
- Kathyrn Masten (self and on behalf of Ingleside on the Bay Coastal Water Association)
- Cliff Schlabach and Neil McQueen (on behalf of Surfrider Foundation)
- Wendy Hughes
- Jennifer Hillard

Hamlet Newsom provided the following comments by email:

- Are raw water supply costs (for groundwater project) shown in the plan?
- Did costs for the Port's Harbor Island and La Quinta Channel sites assume 500 mg/L TDS produced water like those of the City's desalination projects?
- Does Port's Harbor Island facility cost need to be changed given their new plans to put the intake pipe in the Gulf?
- Table 5D.10-4 is missing the dollar amount label for debt service. Pumping energy costs are not included in the annual costs for the City's Inner Harbor and La Quinta desalination projects.

From: Randy Cain
Sent: Monday, June 22, 2020 4:02 PM
To: regionnfeedback@nueces-ra.org
Subject: Comment

To whom it may concern:

I have several comments with regard to the Coastal Bend Regional Water Planning Area Region N: Executive Summary and Initially Prepared Plan, March 2020.

My concerns are in regard to section 5D.10 - “Seawater Desalination.” First, I would like to state for the record that I do not support the intake of millions of gallons of seawater and the discharge of millions of gallons of brine in and out of Corpus Christi Bay every day. The collective impact of five desalination facilities with intake and discharge sites within the Corpus Christi Bay system has the potential to significantly alter the make-up of our local seawater and, thereby, devastate marine life within the estuary. Second, I am especially opposed to the three desalination facilities proposed within La Quinta Channel. La Quinta Channel is a virtually closed system in and around which the environmental impacts of three desalination facilities will be exponentially multiplied. A 2015 study by the Harte Research Institute for Gulf of Mexico Studies found La Quinta Channel, compared to the other proposed locations within CC Bay, to be the site with potential for “the most severe environmental impacts.” In the opinion of the Harte Research Institute, La Quinta “would not be recommended for the construction of a discharge facility.” I ask that this expert research and well-founded concern not be overlooked. Third, while the Regional Water Planning Summary recognizes the joint 2018 study published by the TPWD and Texas GLO on intake and discharge zones for desalination facilities in Texas, the plan does not take into account that the TPWD and Texas GLO study specifically proposed off shore intake and discharge locations. My question is: why are the results of this State sponsored study not being followed? Why risk an environmental disaster within Corpus Christi Bay, when environmentally safe sites for intake and discharge have already been identified off shore? Finally, I request, prior to any continued plans for desalination intake and discharge zones within the Corpus Christi Bay system, the completion of an Environmental Impact Statement (EIS) and the hosting of a public meeting by the TCEQ.

Thank you,

From: Emily Nye <email address redacted>
Sent: Thursday, June 25, 2020 1:05 PM
To: regionnfeedback@nueces-ra.org
Subject: Comment

To whom it may concern:

I have several comments with regard to the *Coastal Bend Regional Water Planning Area Region N: Executive Summary and Initially Prepared Plan, March 2020*.

My concerns are in regard to section 5D.10 - “Seawater Desalination.” First, I would like to state for the record that I do not support the intake of millions of gallons of seawater and the discharge of millions of gallons of brine in and out of Corpus Christi Bay every day. The collective impact of five desalination facilities with intake and discharge sites within the Corpus Christi Bay system has the potential to significantly alter the make-up of our local seawater and, thereby, devastate marine life within the estuary. Second, I am especially opposed to the three desalination facilities proposed within La Quinta Channel. La Quinta Channel is a virtually closed system in and around which the environmental impacts of *three* desalination facilities will be exponentially multiplied. A 2015 study by the Harte Research Institute for Gulf of Mexico Studies found La Quinta Channel, compared to the other proposed locations within CC Bay, to be the site with potential for “the most severe environmental impacts.” In the opinion of the Harte Research Institute, La Quinta “would not be recommended for the construction of a discharge facility.” I ask that this expert research and well-founded concern not be overlooked. Third, while the Regional Water Planning Summary recognizes the joint 2018 study published by the TPWD and Texas GLO on intake and discharge zones for desalination facilities in Texas, the plan does not take into account that the TPWD and Texas GLO study specifically proposed *offshore* intake and discharge locations. My question is: why are the results of this State sponsored study not being followed? Why risk an environmental disaster within Corpus Christi Bay, when environmentally safe sites for intake and discharge have already been identified offshore? Finally, I request, prior to any continued plans for desalination intake and discharge zones within the Corpus Christi Bay system, the completion of an Environmental Impact Statement (EIS) and the hosting of a public meeting by the TCEQ.

Thank you,

Emily Nye

From: Patrick A. Nye
Sent: Wednesday, June 24, 2020 4:39 PM
To: regionnfeedback@nueces-ra.org
Subject: Comments for Region N

Please accept this email as my comments for the TWDB Region N Virtual meeting.

Based upon the environmental risks I am NOT in favor of any desalination facilities that utilize Corpus Christi Bay waters. The TPWD, Harte Research Institute, UT Marine Science Institute and other institutions have opposed this action suggesting that desalination facilities utilize waters from the Gulf of Mexico offshore of Padre and Mustang Islands.

Models for these facilities assume that salinities would not change by more than 1ppt and does not take into account the relationship with oxygen levels that are linked. Valuable marine larvae will be destroyed by just the intake alone with no data supporting the cumulative effects of brine concentrations within our bay systems over time. Usage proposed for these desalination facilities are not including the additional discharges from the industries that will utilize the fresh water.

In effect, we are exchanging our quality of life to become the dumping grounds of industry byproducts and brine.

Thank you.

Patrick A. Nye

President

Nye Exploration & Production, LLC

Ingleside on the Bay Coastal Watch Association
Patrick A. Nye, President
1018 Bayshore
Ingleside, Texas 78362

August 1, 2020

Coastal Bend Regional Water Plan Region N
regionnfeedback@nueces-ra.org

RE: Region N Regional Water Plan Comments

Dear Sir or Madam,

On behalf of the Ingleside on the Bay Coastal Watch Association (IOBCWA), as President of the Board of Directors, I am submitting these comments to be considered for Coastal Bend Regional Water Plan Region N (PLAN) water planning. (See Slide #1) Specifically, our community opposes the implementation of desalination facilities within Corpus Christi Inner Harbor, La Quinta Channel and Harbor Island. Ingleside on the Bay is only one of many communities directly affected by desalination. Shown on Slide 2 are the seven (7) desalination facilities located within Corpus Christi Bay system. The Region N Water Plan is impressive but lacks the long-term vision and practicality of economic and environmental consequences. My comments are shown below and slides pertaining to the comments attached:

1) Has the PLAN considered utilizing the cooling waters from various refineries for reuse? Exxon-SABIC will dump 9.03 MGD with a maximum discharge at 13.24 MGD into La Quinta Channel, or 23.75% and 33.1% respectively of the City of Corpus Christi's La Quinta Channel desal project. (See Slide #3) How many millions of gallons per day (MGD) of cooling water is discharged into the bay for Voestalpine, Cheniere, Oxy and Chemours? Could this freshwater water be recycled and reused instead of supporting the more costly and toxic desalination? The Coastal Bend could be a nationwide example of water conservation. Could the PLAN mandate recycling of cooling water strategy to industries within the Port of Corpus Christi as well? Has the PLAN considered the use of seawater to be properly pumped through stainless piping for cooling eliminating the need for salinity brine discharge? La Quinta Channel has three pending desalination facilities totaling 170 MGD of fresh water produced. This is well beyond the needs of Region N. Total brine discharge from the permits filed for La Quinta Channel is 326.3 MGD! (See Slide 4) If the City of Ingleside facility is removed from the calculations, then using just the POCC and City of CC desalination facilities would drain La Quinta in 97 days through the intake and fill La Quinta with brine in 154 days. (See Slides #5 & 6) Similarly, using a conservative 2500 ac/ft within the City of Corpus Christi Marina, after removing all of the boats and T-Heads and using a generous 10' depth, the Inner Harbor desalination facility would drain that area in approximately 10 days and fill that same area with brine in 12 days. (See Slides #7 & #8) What happens to the Texas State Aquarium seawater intake that is vital for supporting sea life within the Aquarium?
2) Brownsville Ship Channel seawater desalination pilot project cost $67 million during the 2004-2008-time frame and was projected to produce 2.5 MGD of freshwater. This project had multiple

problems including turbidity, suspended solids as well as temperature variations by passing ship traffic. The same problems exist for facilities within Corpus Christi Bay. (See Slide #9)

3) M&G Resin desalination facility in POCC inner harbor has been bankrupt and now has been taken over by Water Cycle LLC slated for operations in the Summer of 2020. Has this facility ever made potable water from seawater? Before the PLAN recommends taxpayer's monies being spent on desalination in the Coastal Bend, shouldn't the PLAN first determine if this project is even cost effective? (See Slide #10)
4) What happens if a desalination project goes bankrupt as many have around the world? (See Slide #11) Will taxpayers bear the costs to operate? Will municipal water supplies be available during a drought?
5) The City of Corpus Christi's La Quinta Channel seawater desalination project is for industrial use with an insignificant amount used for municipal. The science shows major concerns are the balance of salinities within Corpus Christi Bay (See Slide #12) and with brine buildup within the channel over time. (See Slides #13 & #14) Brine salinities will cause major environmental issues. (See Slide #15) Has the CBRWP consulted with Texas Parks and Wildlife (TPWD) as well as the Texas General Land Office (GLO) concerning the locations of the desalination projects? Specific recommended desalination sites offshore in the Gulf of Mexico have been chosen by TPWD and the GLO. Why are these sites not the first considered by the PLAN for desalination projects? (See Slides #16 & #17) Must Corpus Christi Bay, La Quinta Channel, Ingleside Cove and Ingleside on the Bay bear the disproportionate environmental costs of desalination primarily for industrial growth? Municipal water use decreases through 2070 while industry increase over the same period. (See Slides #18 & #19)
6) As a petroleum geologist, every well drilled sets casing to protect groundwater. Newer technologies incorporating horizontal drilling for potable and brackish water could be implemented for long term water resources. By drilling horizontally up dip into the formation, gravity pressure would supplement some of the pumping costs. (See 5D8.7) Have drilling and equipment costs been reviewed since the oil crash of 2020 and compared to seawater desalination facilities for municipal use? The Evangeline Formation would be a perfect reservoir for this. (5D.9) In addition, there are many abandoned wells around Sinton, Texas that could be converted to disposal wells for the brine. Wind electricity could be purchased with long term contracts to supply the energy needs of the project. (See Slide # 20)
7) The PLAN claims that their entire responsibility is at "reconnaissance-level". In the event of environmental impacts within the discharge basin of Corpus Christi and Nueces Bays, what level of liability does the PLAN retain? There are many other questions yet to be answered by desalination that The Plan must address. (See Slide #21)

Recommendation: An Environmental Impact Statement (EIS) needs to be conducted for desalination facilities and to include ALL the combined and cumulative effects of the current and planned developments in Corpus Christi Bay. The expert scientists who know the estuaries and coastal waters of Texas best, such as those from TAMU's Harte Research Institute and Conrad Blucher Institute and UT's Marine Science Institute, should be engaged in doing the requisite studies.

Conclusion: IOBCWA opposes seawater intake and brine discharge from any desalination projects within the Corpus Christi Bay system and requests an Environmental Impact Statement (EIS). (See Slide #20) Especially during these challenging pandemic times, it's more important than ever for the Coastal Bend Regional Water Plan Region N to ensure that beautiful coastal communities surrounding Corpus Christi Bay survive and thrive – offering respite in recreational opportunities and sustainable fishing that everyone can safely enjoy. IOBCWA recommends that any desalination facilities be "taken offshore" as recommended by TPWD and GLO. (See Slide #21)

Sincerely yours,

Patrick A. Nye

Patrick A. Nye
President IOBCWA

CC: Senator Judith Zaffirini
Rep. J.M. Lozano
City of Ingleside on the Bay

IOB Coastal Watch Association, Inc.

COMMENTS BY PATRICK NYE, PRESIDENT

REGION N REGIONAL WATER PLAN

JULY 30, 2020

Coastal Bend
Regional Water Planning Area
Region N

Executive Summary and
Initially Prepared Plan
March 2020

Prepared for

Texas Water Development Board

Prepared by

Coastal Bend Regional Water Planning Group

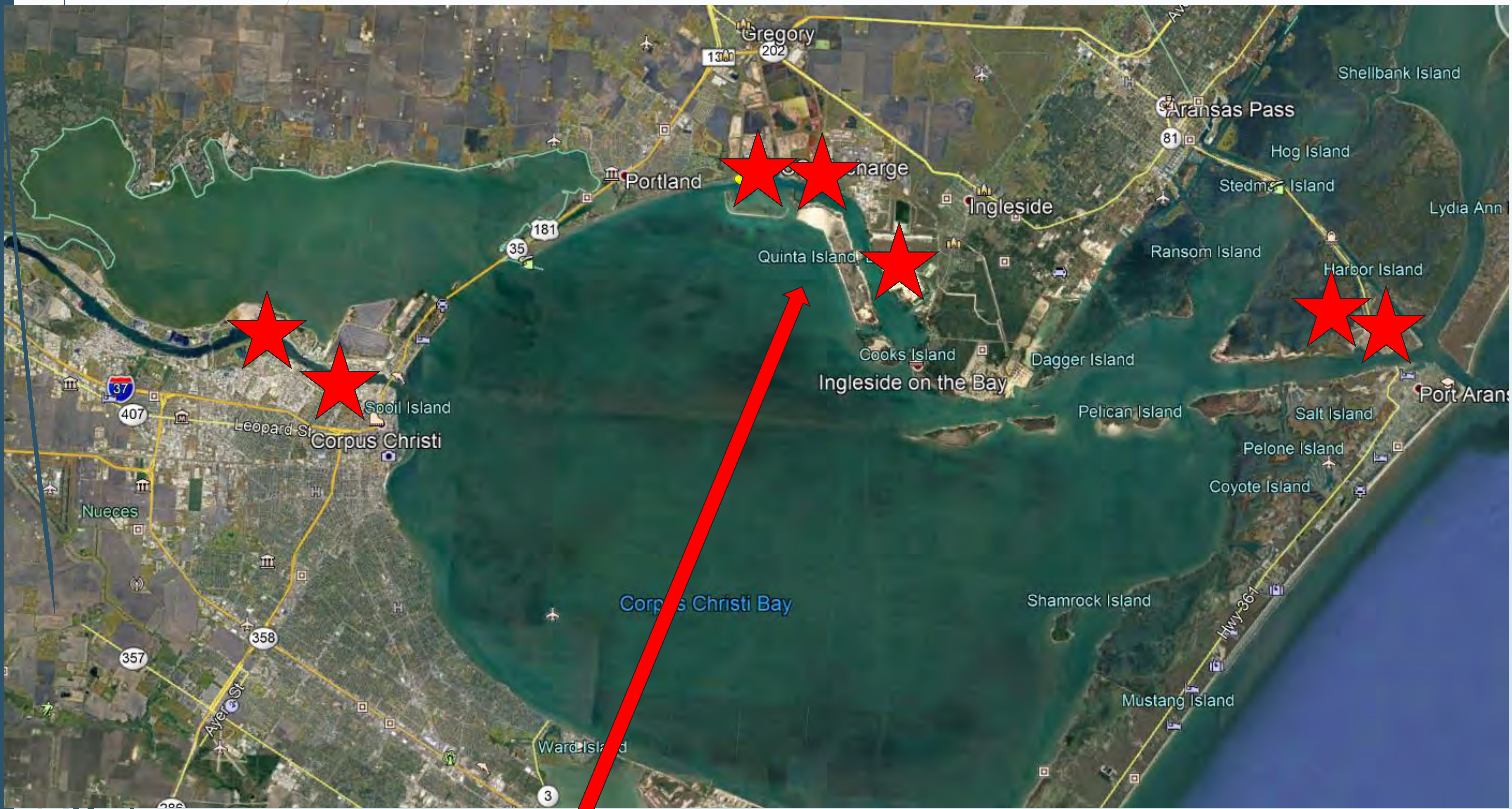
With administration by

With technical assistance by

HDR Engineering, Inc

SEVEN DESALINATION FACILITIES WITHIN CORPUS CHRISTI BAY SYSTEM PROPOSED

SLIDE 2



THREE DESALINATION FACILITIES WITHIN LA QUINTA CHANNEL - A CLOSED SYSTEM WITH LITTLE WATER CIRCULATION

EXXON-SABIC TO USE 20MGW & DISCHARGE 9.

TCEQ Public Meeting: EXXON/SABIC Industrial Wastewater Permit

December 11, 2017 @ 7:00 pm - 10:00 pm

The TCEQ has scheduled a Public Meeting on Exxon's permit to discharge industrial wastewater and stormwater into Coprus Christi Bay and Copano Bay/Port Bay/Mission Bay via pipe and open drainage ditches.

THE MEETING IS SCHEDULED TO COMMENCE AT 7 PM ON DECEMBER 11 AND WILL BE HELD AT STEPHEN F. AUSTIN ELEMENTARY SCHOOL IN GREGORY.

The meeting will begin with an Informal Discussion Period during which citizens can direct questions to Exxon/SABIC and TCEQ staff. After the discussion period, citizens can make formal comments for the record.

Exxon cannot build the facility unless they 1) receive an air quality permit, and 2) obtain a permit to discharge the industrial wastewater into the bays. Please share notice of this meeting with all who have an interest in the water quality of our bays and estuaries.

As a reminder, Exxon will require 20 Million gallons of water per day to operate, or 7.3 Billion gallons each year. After this water passes through their processes, they will discharge 9 Million gallons of water each day, or 3.3 Billion gallons each year. Stormwater runoff from approximately 1.5 square miles of concrete will flow to the bays.

BACKGROUND

The Applicant, who proposes to operate a chemical manufacturing facility that will produce ethylene, monoethylene glycol, and polyethylene, has applied for a new TPDES Permit, No. WQ0005228000, to authorize the discharge of treated process wastewater, cooling tower blowdown, maintenance wastewater, water treatment wastewater, railcar wash water, miscellaneous wastewaters, wastewater from commissioning activities, and stormwater at a daily average flow not to exceed 9.03 million gallons per day (MGD) and daily maximum flow not to exceed 13.24 MGD via Outfall 001 and stormwater and allowable non-stormwater on an intermittent and flow-variable basis via Outfalls 002, 003, 004, and 005.

DESAL PERMITS SUMMARY

SLIDE 4

Port of Corpus Christi La Quinta Channel facility –

Source: Discharge Permit application, Water Rights Permit application, and Region N Water Planning Group

- Location – approximately 2,200 feet east of the Bay Ridge subdivision in Portland, near the Exxon heavy haul road
- Intake – 90.4 million gallons per day
- Brine Discharge – 57,300,000 gallons per day
- Freshwater Yield – 30 million gallons per day – *for industrial use only*

City of Corpus Christi La Quinta Channel facility –

Source: Water Rights Permit application, and Region N Water Planning Group

- Location – on La Quinta Channel, between Chemours and the old Sherwin Alumina site
- Intake – 111 million gallons per day
- Brine Discharge – 69 million gallons per day
- Freshwater Yield – 40 million gallons per day – *for primarily industrial use*
- WITHIN PERMIT COMMENT PERIOD

City of Ingleside La Quinta Channel facility – *Source: Water Rights Permit application, and Region N Water Planning Group*

- Location – on La Quinta Channel, unspecified location
- Intake – 120-225 million gallons per day
- Brine Discharge – 100-200 million gallons per day
- Freshwater Yield – 50-100 million gallons per day – *for industrial use*
- PERMIT NOT FILED

LA QUINTA & INGLESIDE COVE – Total Intake Volume- POCC+CITY of CC

DESAL AREA CONSIDERED A CLOSED SYSTEM
VERY LIMITED WATER CIRCULATION

TOTAL INTAKE VOLUME CITY OF CC ONLY – 175 DAYS TO DRAIN

LA QUINTA & INGLESIDE COVE
Total Discharge Volume POCC+ CITY of CC

TOTAL DISCHARGE VOLUME CITY OF CC ONLY – 282 DAYS TO FILL

SLIDE 7

INNER HARBOR DESAL

Total Intake Volume CITY of CC

INNER HARBOR DESAL

Total Brine Discharge Volume CITY of CC

DESALINATION FACILITIES THAT FAILED

Estimated cost to build a 2.5 MGD seawater desal plant in the ship channel: $67 million (2008)

Brownsville did a government-funded pilot seawater desal plant 2004, within the local ship channel

Figure ES-1: Location of the Brownsville Seawater Desalination Pilot Project.

<u>Major problems</u>: turbidity, suspended solids and temperature variations caused by passing ships!

DESALINATION FACILITIES THAT FAILED

2.1.2 Corpus Christi, Texas M&G Resins USA, LLC

M&G Resins USA, LLC in Corpus Christi, Texas was issued a TPDES Permit WQ 0005019000 on October 23, 2014 with an expiration date of June 1, 2017 to discharge 9.4 MGD of RO brine concentrate and pretreatment waste into the Corpus Christi Inner Harbor, Water Quality Segment 2484. The permit was amended and re-issued on April 19, 2016 to allow a discharge of 18.9 MGD with expiration on June 1, 2020 and again amended and re-issued on October 26, 2017 to allow a discharge of 38.5 MGD with expiration on June 1, 2022.

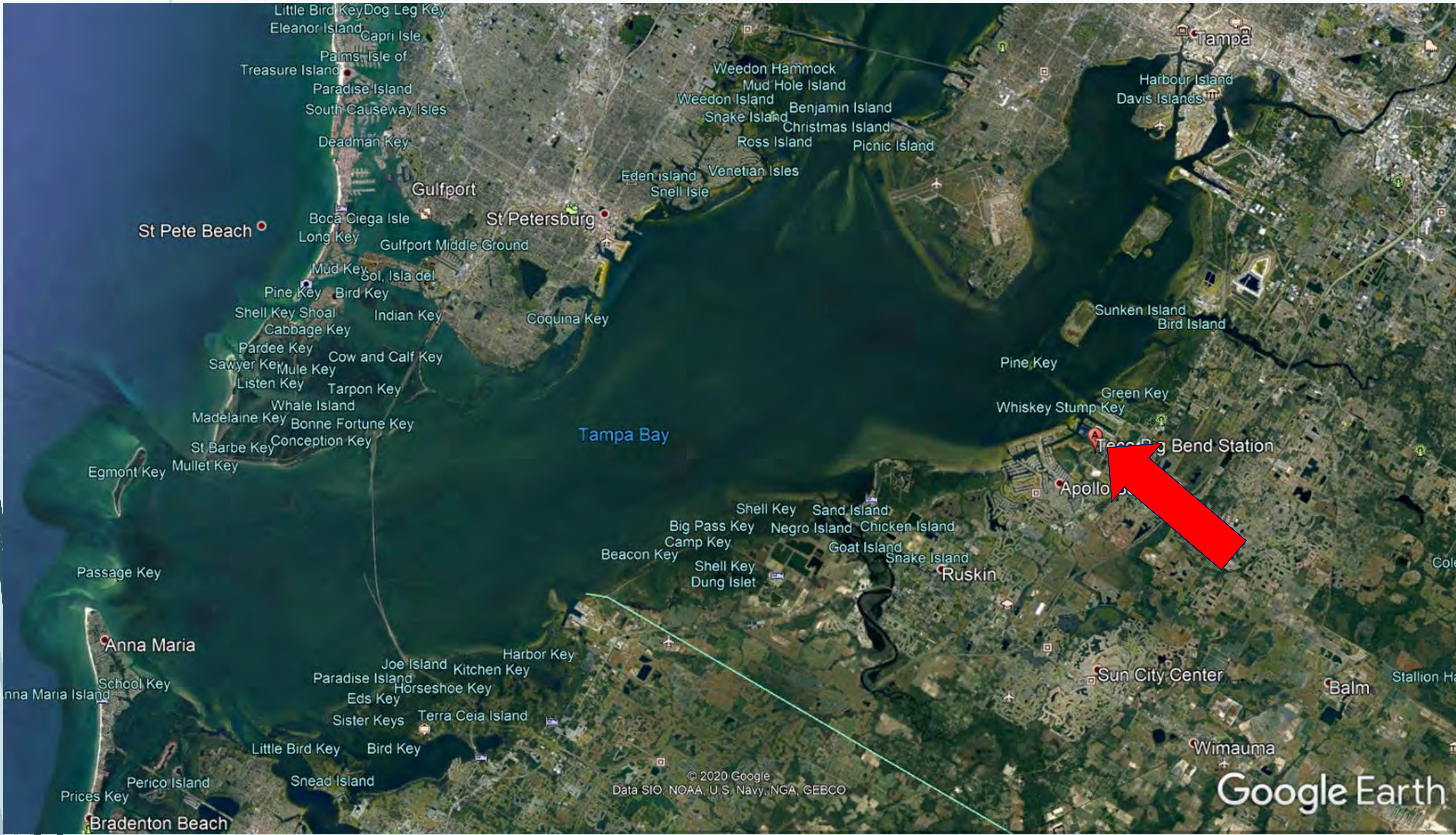
The permit was transferred from M&G Resins USA, LCC to Corpus Christi Polymers, LLC on February 28, 2019. The operator, Water Cycle, LLC, anticipates start of operations in summer 2020.

The layout and design of the Tampa Bay Seawater desal plant

Cost (2010) - $150 million to construct;
sometimes producing 25 MGD

Location –adjacent to the TECO coal/gas fired power plant within Tampa Bay

(The plant has been bankrupt several times since opening)

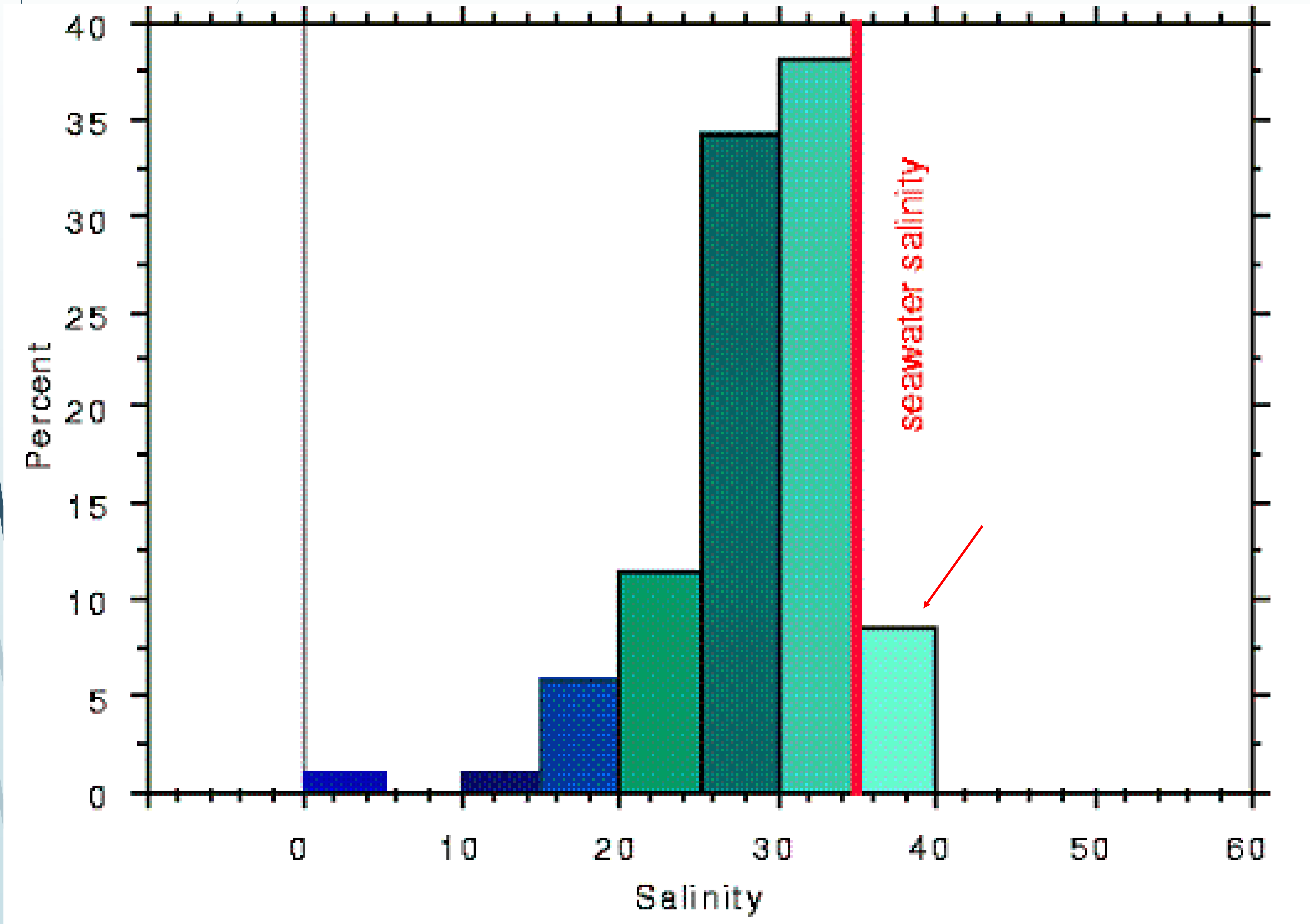


Supplied by W. Vernon Kramer

Corpus Christi Bay Salinity

Samples taken various locations CC Bay

It would not take much to upset salinity balance!



Supplied by W. Vernon Kramer

CITY OF CORPUS CHRISTI DESALINATION PERMIT # WQ0005290000

SLIDE 13

LREWater, LLC
a Leonard Rice Engineers Company

Integrated Water Resources Engineering
Innovative Solutions for Water and Land

Desalination Brine Discharge Modeling – Corpus Christi Bay System

To:	Sarah L. Garza, Director of Environmental Planning & Compliance Port of Corpus Christi
From:	Jordan Furnans, PhD, PE, PG LRE Water, LLC
Copy	Ben R. Hodges, PhD The University of Texas at Austin
Date:	October 21, 2019

Executive Summary

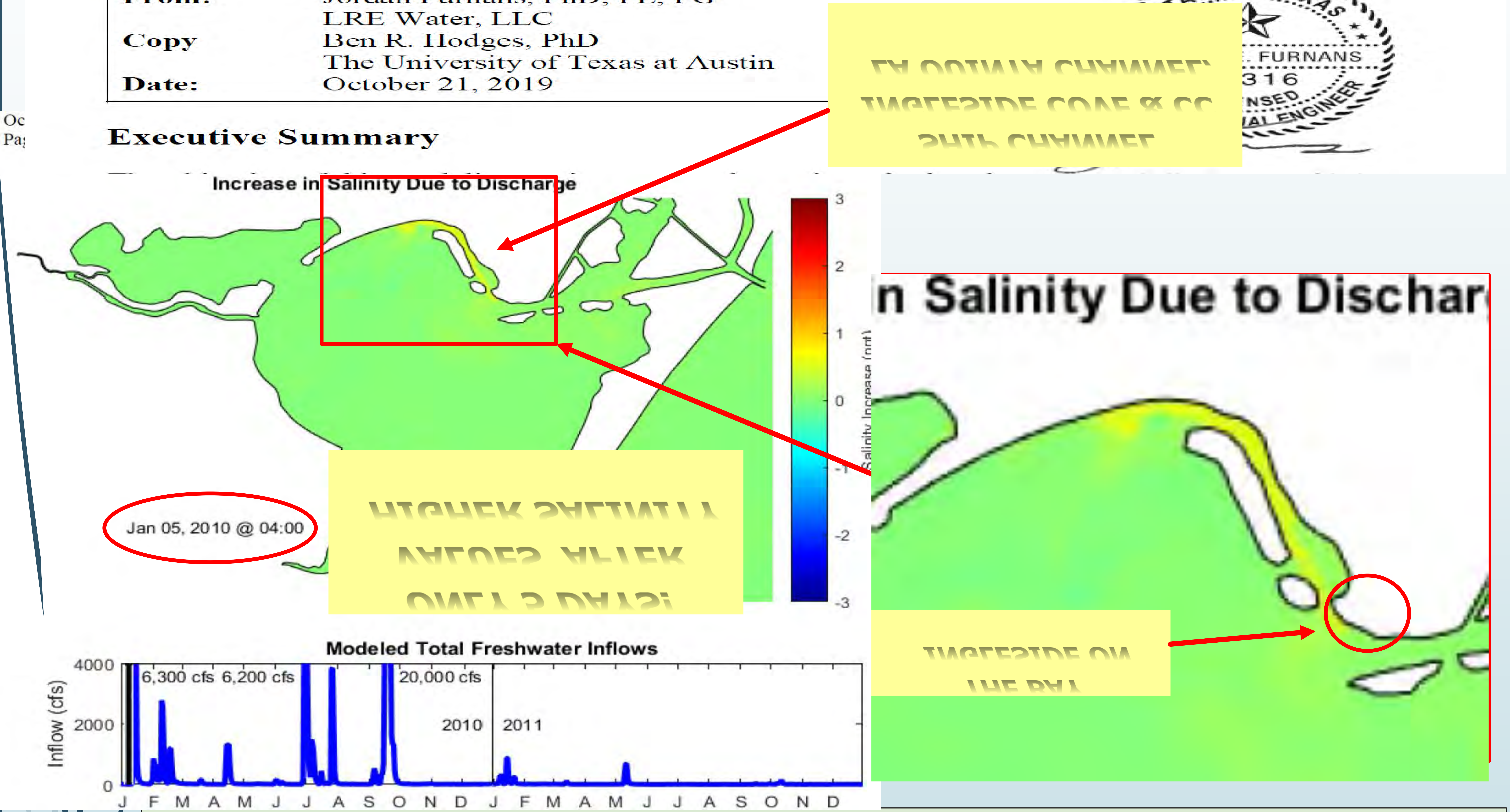


Figure 19 – Modeled Bottom Salinity Increase Resulting from Proposed Harbor Island & La Quinta Channel desalination brine discharges, shown for January 5, 2010. Increase is defined as the difference in bottom salinity between models including and excluding the desalination brine discharges. Note: the SUNTANS model does properly simulate the La Quinta Channel discharge due to the coarse model grid in the vicinity of the channel. The modeled La Quinta Channel discharge is estimated as the diffuser design for the proposed facility has yet to be finalized.

CITY OF CORPUS CHRISTI DESALINATION PERMIT # WQ0005290000

LREWater, LLC
a Leonard Rice Engineers Company

Integrated Water Resources Engineering
Innovative Solutions for Water and Land

Desalination Brine Discharge Modeling – Corpus Christi Bay System

To:	Sarah L. Garza, Director of Environmental Planning & Compliance Port of Corpus Christi
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Copy	Ben R. Hodges, PhD The University of Texas at Austin
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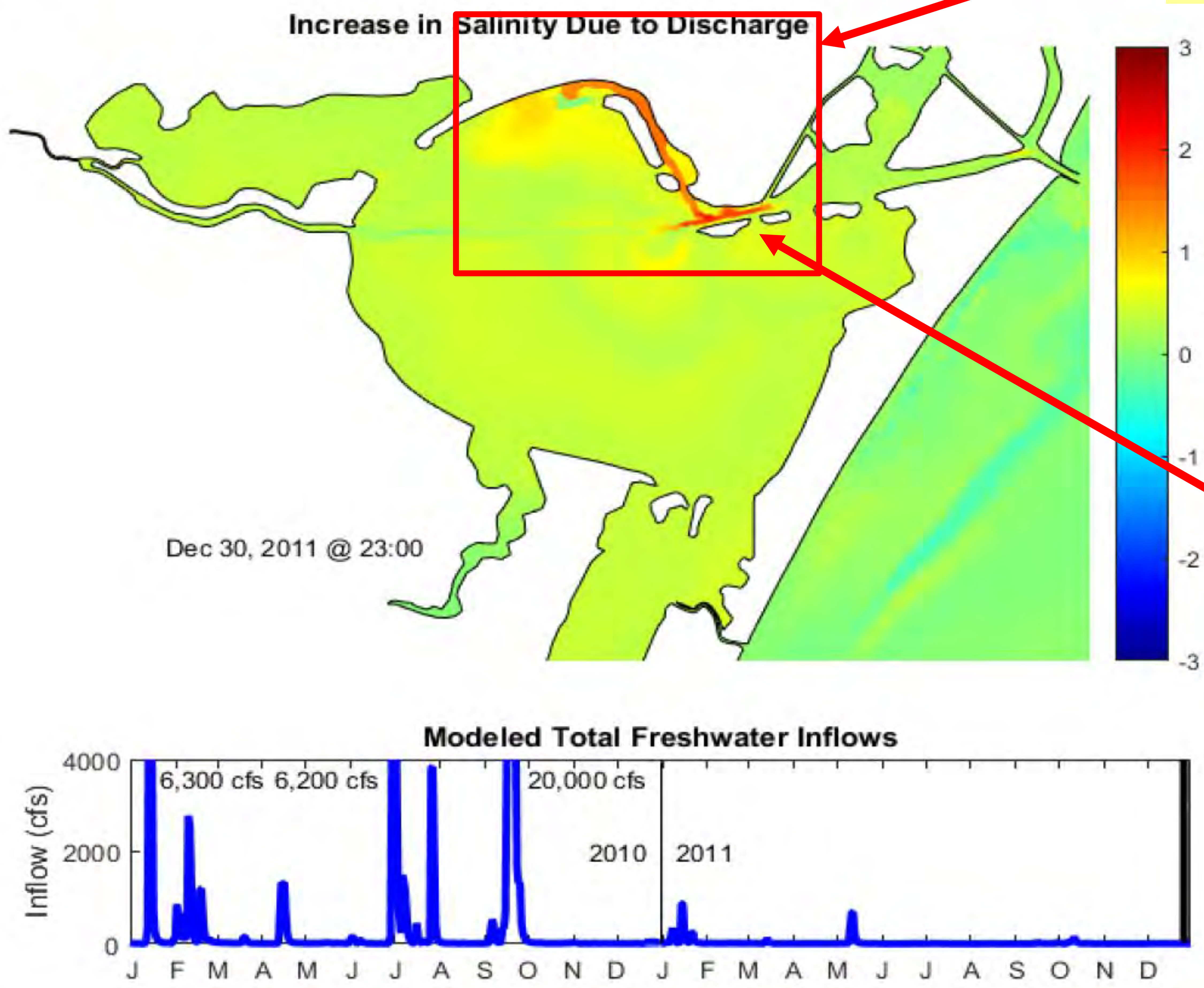


HIGHEST SALINITY VALUES

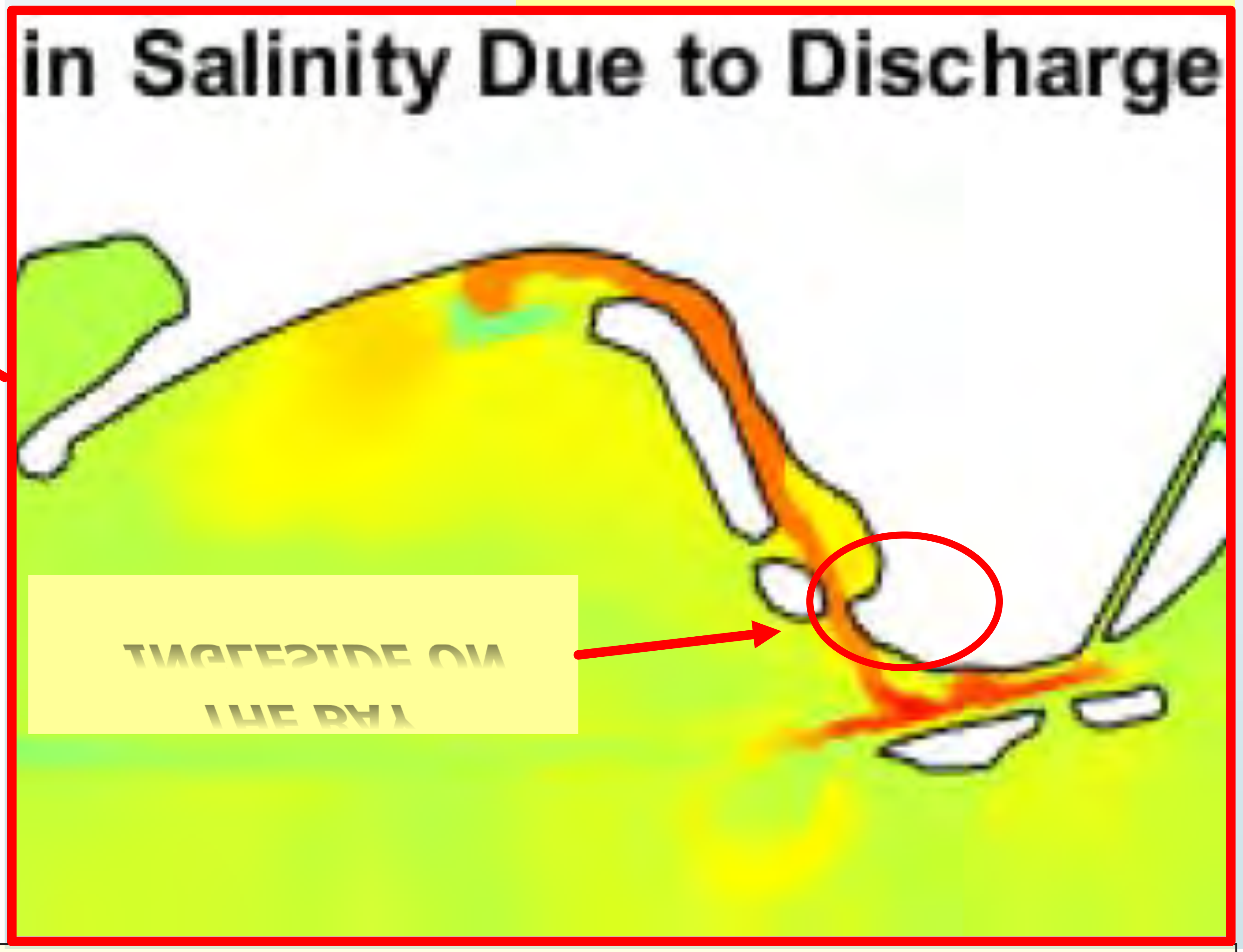


Figure 24 - Modeled Bottom Salinity Increase Resulting from Proposed Harbor Island & La Quinta Channel desalination brine discharges, shown for December 30, 2011, 15 months after the large inflow event. Increase is defined as the difference in bottom salinity between models including and excluding the desalination brine discharges. Note: the SUNTANS model does properly simulate the La Quinta Channel discharge due to the coarse model grid in the vicinity of the channel. The modeled La Quinta Channel discharge is estimated as the diffuser design for the proposed facility has yet to be finalized.

CITY OF CORPUS CHRISTI DESALINATION PERMIT # WQ0005290000

TM 2.1 – Identification and Characterization of Potential Environmental Impacts Mitigation Measures Related to Intake and Discharge Facilities of Seawater Desalination Plants

Variable Salinity Desalination Demonstration Project
City of Corpus Christi

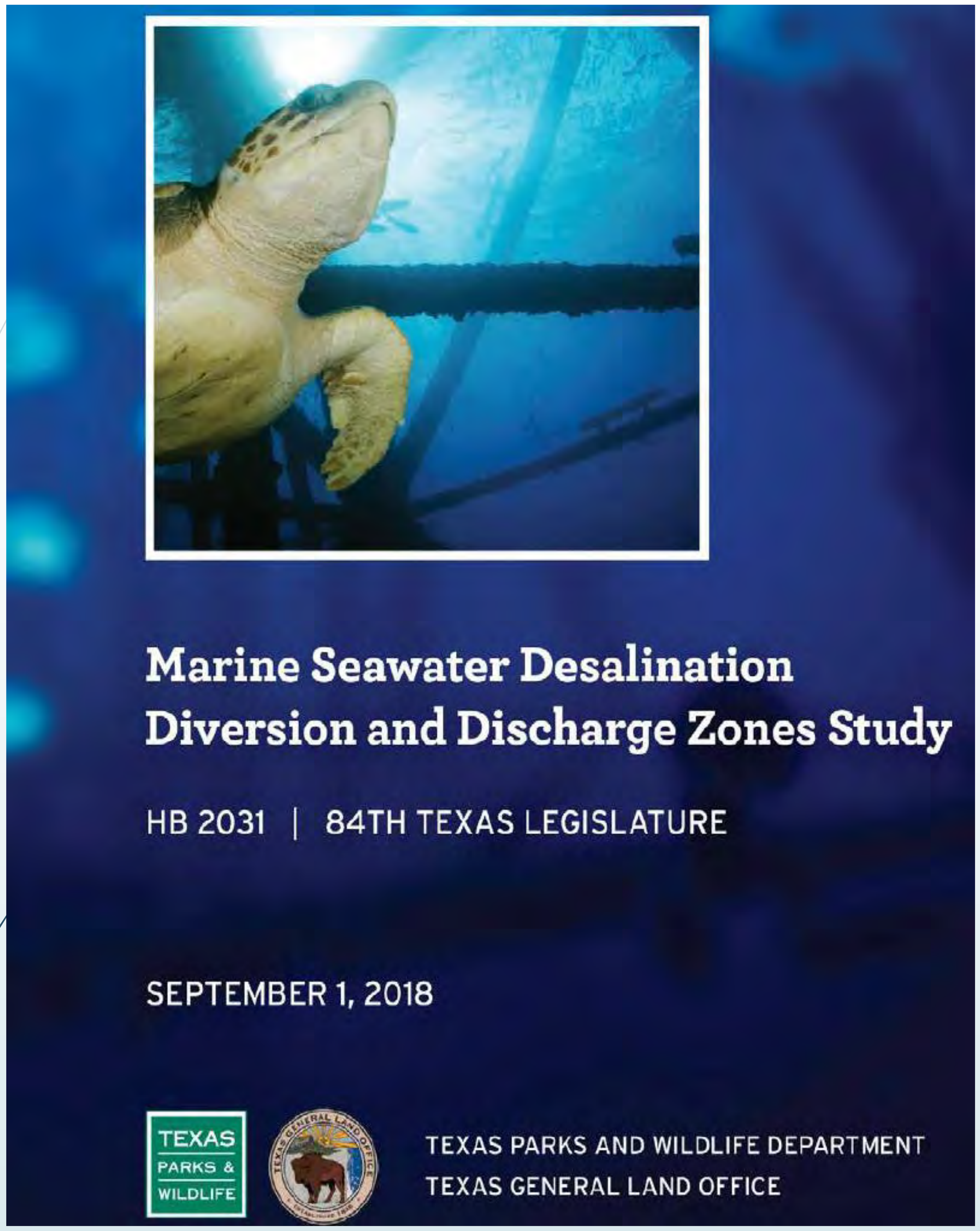
10 July 2015

By Greg Stunz (intakes) and Paul Montagna (discharges)
Harte Research Institute for Gulf of Mexico Studies
Texas A&M University-Corpus Christi

Site 2: La Quinta Channel Extension

Discharge location 2A is located southwest of La Quinta Channel Extension in Corpus Christi Bay. The proposed types of discharge infrastructure are submerged pipe and submerged jet diffusers. Nearby tidal flats, salt marshes, and seagrass beds are inhabited by protected bird species and used as recruitment areas by recreationally important fish species. Green sea turtles, bottlenose dolphins, and manatees have been observed in La Quinta Channel. Hypoxia or anoxia would occur as a result of submerged pipe brine plume discharge. This site would have the most severe environmental impacts and would not be recommended for the construction of a discharge facility.

TEXAS PARKS & WILDLIFE DEPT. & TEXAS GENERAL LAND OFFICE RECOMMENDATION TO 84TH LEGISLATURE



Pursuant to the requirements of House Bill (HB) 2031 (84th Legislature), the Texas General Land Office (GLO) and the Texas Parks and Wildlife Department (TPWD) have prepared the attached report to identify zones in the Gulf of Mexico that are appropriate for the diversion of marine seawater and for the discharge of marine seawater desalination waste while taking into account the need to protect marine organisms. Results from the study are intended to inform the new optional expedited permit application program authorized by HB 2031 under development at the Texas Commission on Environmental Quality (TCEQ).

SLIDE 17

TAKE IT OFFSHORE!

Figure 21 found in "Marine Seawater Desalination Diversion and Discharge Zones Study" by Texas Parks and Wildlife Department & Texas General Land Office

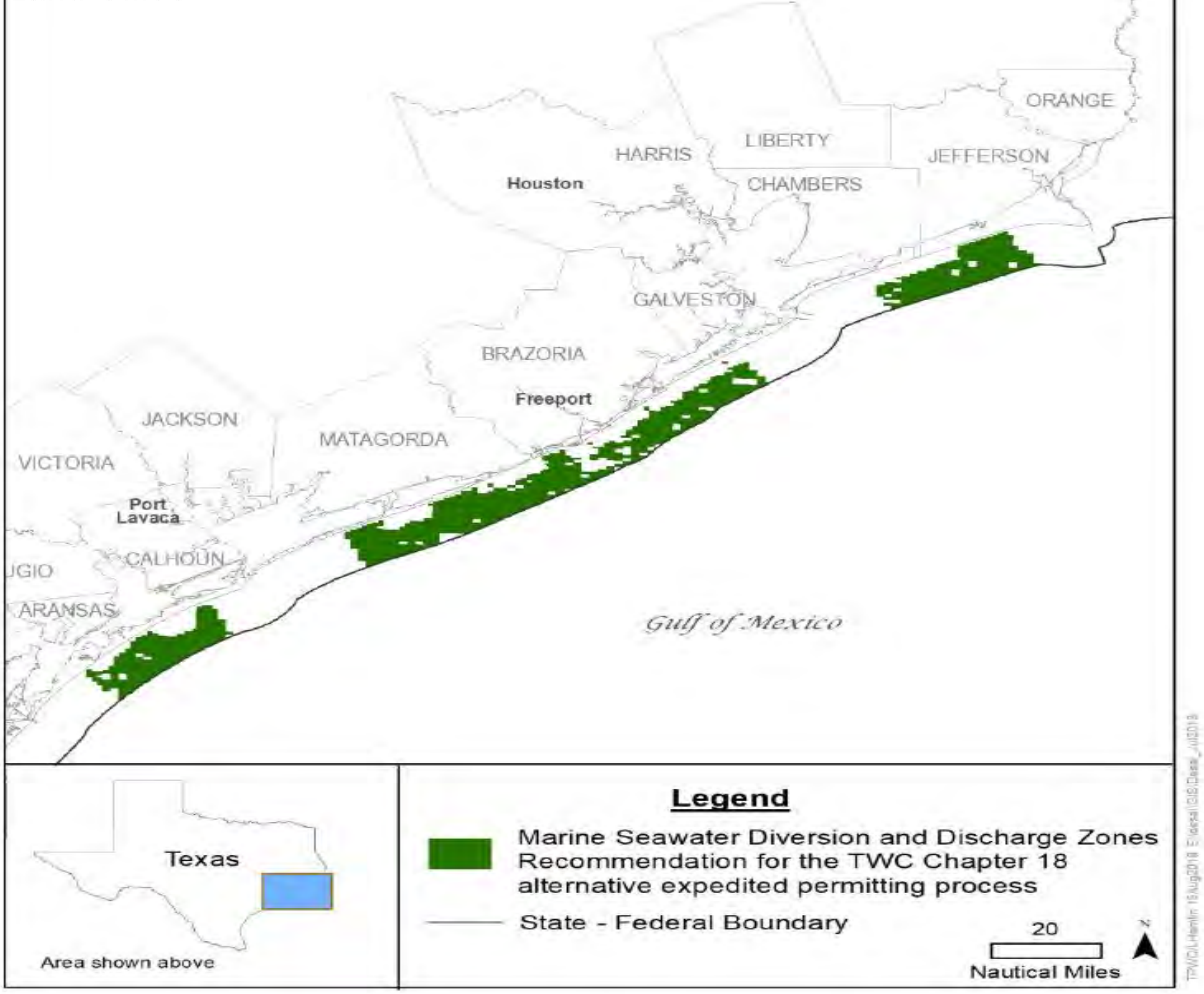


Figure 21. Map of zones for the upper coast. The green polygons represent marine seawater diversion and discharge zones recommendation for the TWC Chapter 18 alternative expedited process.

FIG. ES.2 ILLUSTRATES THAT WATER DEMAND IN SAN PATRICIO CO. REMAINS CONSTANT.
WHY DOES LA QUINTA CHANNEL, INGLESIDE COVE & INGLESIDE ON THE BAY BEAR THE DESALINATION ENVIRONMENTAL RISKS FOR INDUSTRY?

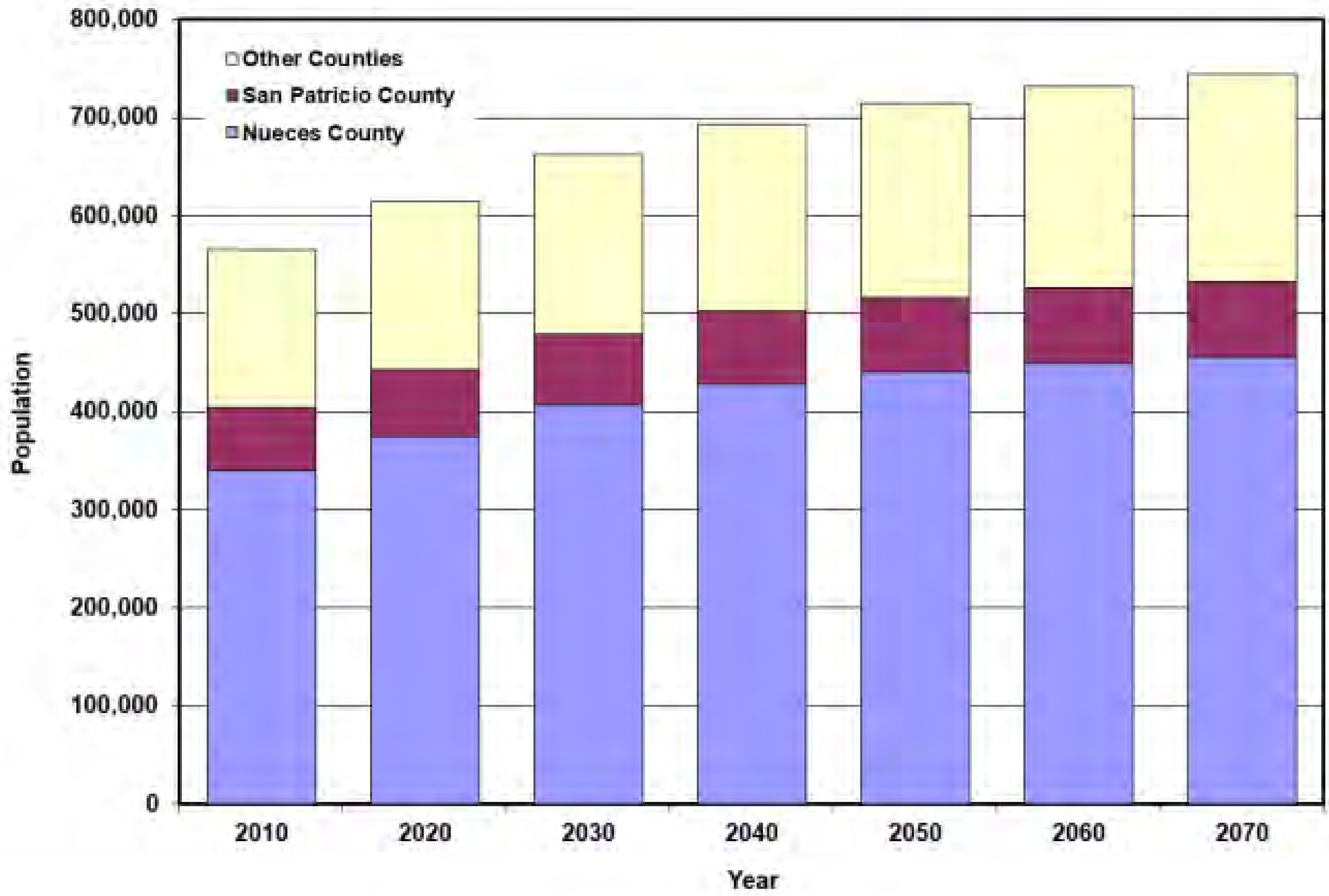


Figure ES.2.
Historical and Projected Coastal Bend Regional Water Planning Area Population

WATER DEMAND MANUFACUTRING INCREASES 11.9% WHY DOES LA QUINTA CHANNEL/SHORELINE OF SAN PATRICIO CO. BEAR THE DESAL BRINE DISPOSAL?

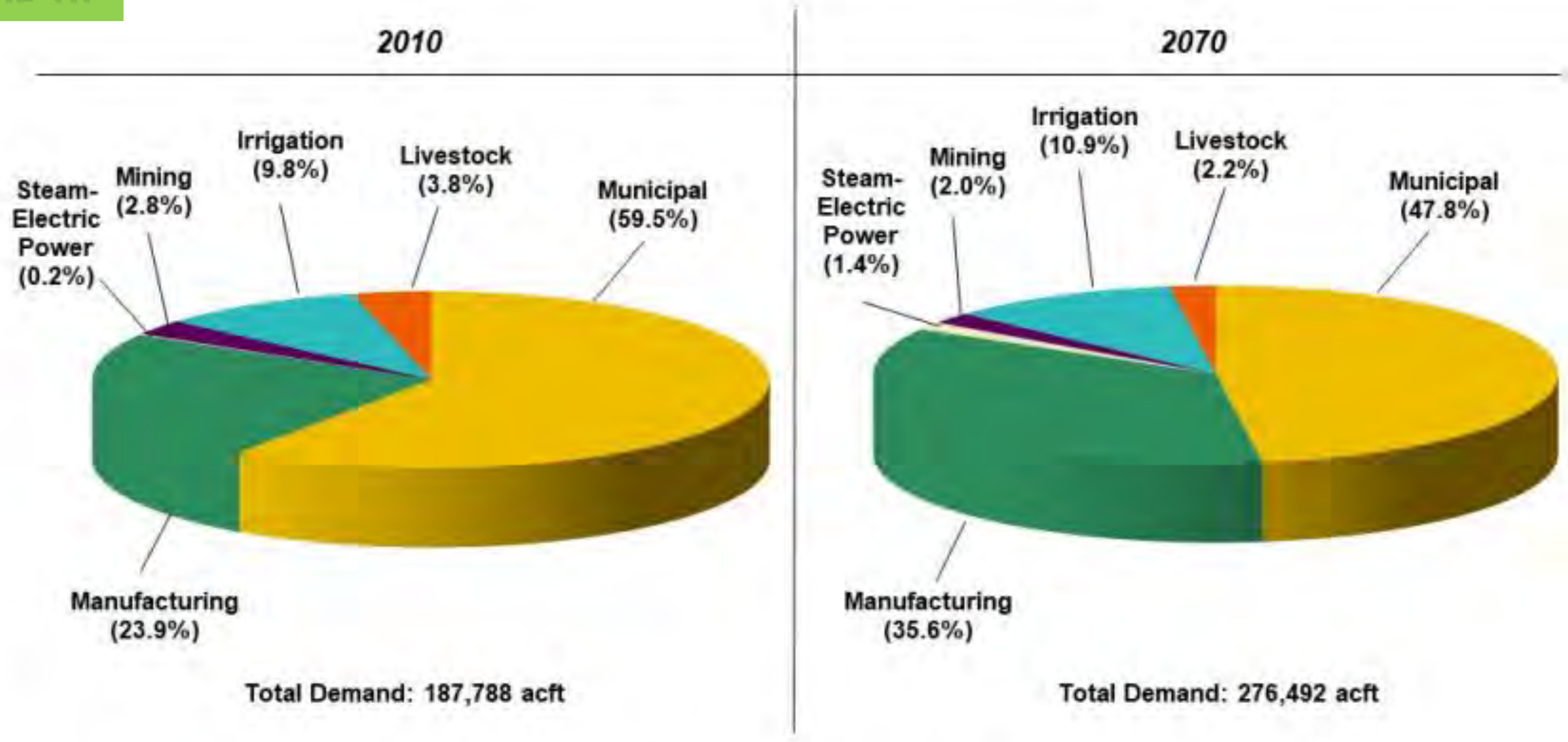


Figure 2.5.
Total Water Demand by Type of Use

FIG. 5D. SHOWS THE LOCATION OF EVANGELINE WATER RESERVOIR NEAR SINTON, TX.
DRILLING WELLS HORIZONTALLY UPDIP UTILIZES GRAVITY FLOW REDUCING COSTS OF PUMPS

SLIDE 50

HDR

Coastal Bend Regional Water Plan | March 2020
HDR-007003-10028677-275994-**015**
Gulf Coast Aquifer Supplies [31 TAC §357.34 & §357.35]

Coastal Bend Regional Water Planning Group

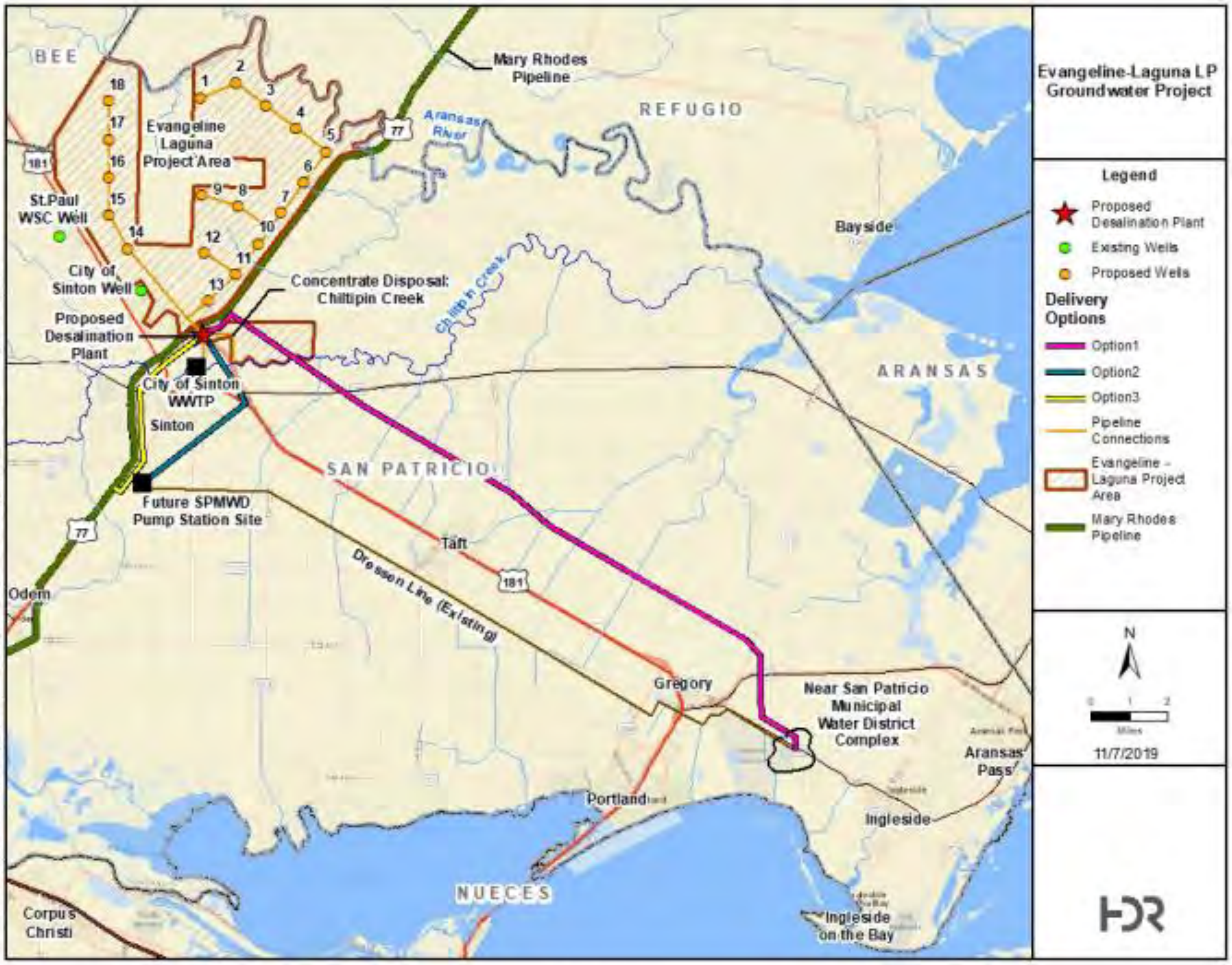


Figure 5D.8.1.
Location of Conceptual Layout of Evangeline/Laguna LP Groundwater Project

OTHER KEY ISSUES

SLIDE 21

- Request for La Quinta circulation studies
  - POCC Sarah Garza stated Jan. 2020 that circulation is an issue
- Environmental impacts to La Quinta, Ingleside Cove, IOB, CC Bay and surrounding areas
- TPWD have stated their opposition to La Quinta desal location
- Disposal of screens, filters, and byproducts from intake lines
- Chemical impacts for intake and discharge
- Not for community water use – only for industry
- Historically – seawater desal is a waste of money
- Negative impact to recreational fishing & guide fishing/hunting
- Impingement of marine life on screens
- Entrainment of marine life in plant
- Impacts on seagrass & other sensitive marine areas
- Impacts on coastal wetlands
- Environmental issues with federally protected Piping Plover, turtles & migrating/nesting birds

SLIDE 22

Gregory
Aransas Pass
Portland
Ingleside
Ransom Island
Quinta Island, La
Ingleside on the Bay
Dagger Island
Pelican Island
Salt Island
Port Aransas
Pelone Island
Coyote Island
Spoil Island
Corpus Christi
Take it
Shamrock Island
Corpus Christi Bay
Mustang Island
OFF
Ward Island
Crane Islands
SHORE
Pita Island
Chapman Ranch
7.19 mi
North Bird Island
Google Earth
Imagery Date: 1/31/2020 lat 27.728719° lon -97.175054° elev -6 ft eye alt 32.54 mi

To: Coastal Bend Regional Water Date: July 28, 2020

Planning Group Subject: Coastal Bend Regional Water

Cc: Elected Officials and Various Other Stake Holders Plan (March 2020) Comments

From: Encarnacion (Chon) Serna

General Comments

The Coastal Bend **does not need desalination plants to provide** Coastal Bend residents with potable water. The average annual population growth over the next 50 years is only .421 %. The real reason as to why The City of Corpus Christi (The City) and the Port of Corpus Christi (The Port) want to install these extremely costly, gargantuan, complex, and problematic plants is to satisfy their promises and perhaps already executed commitments they might have already made to Big Oil/Gas and related industries who use these ungodly amounts of potable water. **See the attached fact sheet.** These big industries which require colossal amounts of potable water in their operations will not stop in their efforts to obtain these demands and in the process will corrupt city, county and perhaps even state officials. If their efforts are not stopped by the citizens of the Coastal Bend, their elected officials, and State Agencies, the end results in the near future will be tremendous tax burdens on top of already existing very high taxation on the citizens of the Coastal Bend. And our “God Given” bays, estuaries, and navigation channels will be extremely polluted and rendered useless to other industries that were here before and ecosystems both marine and on land that depend on the healthy water quality of these waters.

The Planning Group, The City, and the Port need to be transparent on this issue. They need to inform the public in detail and in timely and effective ways what these water needs are, and who is wanting these gargantuan volumes of potable water.

It is also no secret, and widely known in our communities and throughout the State, that The City frequently enough contaminates or allows others to contaminate our potable water systems where the water during these contamination periods is only good for **flushing toilets.** And in those instances where they inform the Public as to the reasons for these events, what surfaces is failures to operate and/or maintain the potable water infrastructure properly and in a timely way or in other instances contamination is caused **again** by other irresponsible parties (Industry) also with their failures to operate or maintain cross-tie equipment (backflow preventers) installed, or not properly installed, or not installed at all, between Industry and The City’s potable water networks. In conclusion, if The City is unable to responsibly, reliably, and steadily operate and maintain these simple water treatment and distribution systems to provide its customers, the tax paying citizens with the most basic utility WATER, needs, simple common sense tells everybody who wants to listen that The City will not be able to responsibly (safely and , effectively) be able to maintain and operate the more complicated, complex and gigantic desalination plants. I also have never heard that Port Authorities have ever installed, owned, maintained or operated potable water systems let alone desalination plants. **Are Port Authorities legally chartered or tasked by either Federal, State or Municipal laws to install, operate and or maintain potable water systems or desalination plants for others?**

In addition, The Planning Group, The City and the Port **need to stop adopting and promoting** desalination projects and allow Oil and Gas related Big Industries who are the real beneficiaries and the ones behind these projects to undertake them in their totality and in all aspects, i.e. they should finance and execute all phases of these projects. ***The desalination projects may not be a bad idea if these Big Industries execute these projects in an environmentally safe and well- engineered acceptable way with installations on offshore platforms out in the Gulf of Mexico with safe buffer zones between the Gulf and our bays and of course with all intakes of raw brine and all discharges of the concentrated brine streams and sludges going back to the Gulf.***

If Big Industries do not want to take responsibility for doing these projects the right way, then our local governments **must immediately stop** cuddling with them, making promises and/or commitments behind closed doors, and always catering to them but instead start promoting other different types of industries. Industries that do not require enormous volumes of potable (millions of gallons per day) water and do not pollute like these Big Industries do. The way these desalination projects and others are going about at fast tracking speeds, behind closed doors, and under the radar of key people and organizations is already **"stinking"** and as all corruption is whether it exists at the federal, or the state, or the local levels it will always **stink.**

Comments Pertaining to the Section on Desalination of the March 2020 Regional Water Plan.

Background Sampling and Testing. Has the City of Corpus Christi, the Port, The Planning Group or any other agency or organization recently sampled and analyzed bay water for TDS, salinity, minerals, metals and other components required by state and federal agencies? Various industries already have waste water and storm water permits with the state agencies and already discharge and have been discharging waste water into the bays for a long time. In addition, long draughts, increased warming, and reduced inflows of fresh water into these bays and estuaries have undoubtedly adversely changed TDS, and salinity levels in these waters. Therefore, it is extremely important and for more than one reason to sample and analyze for average and worst condition ranges before proceeding. These background sampling and testing must establish the currently polluted status of our bays before proceeding.

Required Pre-Treatment to Condition Raw Water for Reverse Osmosis. What chemicals will be used in the pre-treatment process? How will they end on the sludge stream to be discharged? What will the chemical composition of the sludge discharge stream be?

The generated sludge from pre-treatment will be about 2% of the raw brine intake (estimated from available documents.) In reviewing the very sketchy and confusing information provided on this document and on the waste water permits located in the City of Corpus Christi data base, permits have already been submitted to the TCEQ for three desalination facilities and two more will be submitted in the near future. This will make a total of five desalination plants all in the millions of gallons of water per day. When the volumetric rates on these sludge streams are estimated (not provided by City and Port documents), and added to the ones provided, the totals come up to something between 9.18 to 12.96 MGD these will be in the range of 1 to 3 large trucks per minute. These trucks will be transporting these sludge volumes to the CEFE landfill Unit in Robstown. Has the City and the Port checked with the Texas Highway Department and with other departments in their own organizations to see if these generated and added 18-wheeler traffic on highways I-37, Hwy 35/181 and other affected highways and roads can handle this additional traffic? In addition, how big is the CEFE Landfill unit? Is it big enough? Will it be manned to off load these gigantic rates and traffic?

The data pertaining to desalination provided by this document is useless for the most part. Table 5D.10.1 is useless, it does not provide the needed information. The raw water data (feed water to the desalination plants) presented in this table is for surface and groundwater sources not for brine from bays, gulfs or oceans and it is not representative of the raw water that The City and The Port intend to use for their desalination projects. The City and The Port intend to use bay water which contains much higher levels of TDS, salinity and minerals, **and in so doing this presents another reason why the City and the Port should not undertake this type of projects.**

Furthermore, the examples presented in this document for the City of Seadrift and Tampa Florida are also not representative samples of what the City and the Port of Corpus Christi are proposing for the Coastal Bend. The Seadrift example is again for a feed water with a very different composition than the feed water proposed by the City and The Port. The Tampa Florida example listed on this document presents on the other hand, nothing but a failed undertaking by the City of Tampa since they overlooked and ignored or did not provide adequate pre-treatment which is very important for the success of the downstream reverse osmosis process. This as alluded in the document resulted in increased costs which most likely the tax paying citizens of Tampa will have to cover. The Tampa desalination project on the other hand represents a very good example of why a city or any other type of governmental agency should not undertake a project of such great magnitude and complexity as a desalination process. The city of Tampa did not pay proper attention to the required pre-treatment processes and ended up with additional costs. These types of projects have various phases which have to be executed successfully for them to succeed. There is the preliminary Study Phase of the project followed by the Engineering/Design phase, the funding phase, the construction phase, the commissioning phase, and finally the operating phase, all of which are complex, complicated and costly for which **Big Industries with large financial and technical resources and not local governmental agencies attempting to be what they are not, and wanting to do projects out of their league (squandering tax payers money) are not equipped financially nor technically to undertake projects of this technical and financial magnitudes.**

However if later the City of Tampa succeeded in commissioning and operating this desalination plant, then the Planning Group should provide the data i.e. financial and operating data for this desalination plant since this is a more applicable case (process like) to what the City of Corpus and the Port are trying to do with bay water as the feed source to the desalination plant.

Insufficient, Generic, Inapplicable and Very Deceiving Information and Data Have Been Provided in Both This Document and the Permit Applications to the TCEQ. The section on desalination contained in this document and the applications found on the City's data base submitted to the TCEQ do not tell the citizens of the Coastal Bend, the TCEQ, and other agencies and organizations that need to know, the extent of the financial burden on the tax payer and on other industries and agencies, plus the damage extent to the water quality of our bays estuaries, navigation channels, and all land affected by this project .along with plant and marine ecosystems. For examples and specifically; what the tax/payer, citizens, agencies and organizations need to know, and need to have **in open public hearings and meetings with the public, via newspaper notifications, local TV channel news, and also through written notifications in public buildings** are the following:

1. What are their water bills going to be after these desalination projects start?
2. What are their electric bills going to be? The desalination plants will need big electric motors?
3. Who will pay for the electric grid infrastructure modifications/additions to supply electricity for the huge electric motors required by the large volume large discharge pressure requirements for the big pumps needed in these gargantuan desalination plants? Are these electricity usage capital and operating costs included in the estimates provided in the 2020 Coastal Bend Water Plan?
4. What are their property taxes going to be when these projects start funding and thereafter until the debt(s) are paid in full?
5. What will be the new appraised/market values of affected residential homes and real estate property in general, after these massive plants get installed along the cost?
6. Exactly how many desalination plants and exactly what capacities (documents list three of the projects to done in three (3) phases each having incremental capacities) will they be designed for? As it is right now it is not known if it will be only one by the Port (in contested hearing) or three; one by the Port, and two by the City (as indicated by the number of permits currently with the TCEQ) or? will it be five as declared on this document.)?
7. Are The City, The Port, and The Planning Group really serious about financing, designing, constructing, commissioning and operating these many (3, 4 or 5?) desalination plants? If so, do they have a mental picture or idea of what the colossal magnitude of the volumetric rates involved would be? And what the impacts would be just on the flow dynamics of the bay(s) (inflows to the bay (s) tidal wave dynamics, velocity of currents, mixing efficiency volume of water of the bay(s) etc.? or are they not really serious and they are throwing these number of projects into the approval system(s) these many applications hopping the TCEQ and the Public would go along with one or some?
8. The Port and the City need to come together and agree on items 6 and 7. and determine together the total overall impact of everything combined, not just one project here, one

project there, hoping the Public and organizations will buy into this “scattered brain” scheme.

9. What are the chemical compositions and the exact volumetric rates of the intakes, and the discharges to the bays, the Gulf, and the landfill(s)?
10. Can these ultimate disposition sites (including landfills, highways and roads) take the gigantic volumetric disposal rates coming from these desalination plants?
11. Properly prepared mass balances are not shown on either the applications to the TCEQ or in this document? So how can the City and the Port submit applications without this information, and expect to be technically complete?
12. The Planning Group, The City, and The Port have not shown successful and convincing modeling or used any other accepted methodologies to determine the real impacts of the intakes and the proposed discharges on the bay(s) and on lands? So how can the City and the Port submit applications to The TCEQ without this information, and expect to be technically complete?
13. At this time The Port and The City have submitted permit applications to The TCEQ without having answered questions and resolved issues mentioned in 6. Through 12. above. Again here, how can the City and the Port submit applications without this information, and expect to be technically complete?
14. Many other questions and issues of concern pertaining to these elusive, deceptive, and poorly prepared applications (also prepared in very gross negligent ways) have been submitted to the TCEQ and proper elected officials. **It would benefit the Coastal Bend Planning Group, The City, and The Port to obtain, review, and to understand these comments, and above all to properly and quickly respond to the Citizens of the Coastal Bend, to Our Elected Officials and to the Proper State and Federal Regulating Agencies.**

<u>In conclusion how can a city, municipality or port authority successfully and appropriately execute projects of this capacity size, of this financial magnitude, with hundreds or perhaps thousands of technical complexities and unknowns?</u>

Respectfully;
Encarnacion (Chon) Serna
<phone number redacted>

Comments Submitted on the Region N 2021 IPP.

My name is Errol Summerlin and my wife and I have lived in Portland Texas for the past 36 years.

I am a member of Cape, the Coastal Alliance to Protect our Environment. I want to take this opportunity to convey some thoughts and concerns we all have on including the proposals for seawater desalination as presented in the IPP. The proposals submitted by the City of Corpus Christi, the Port of Corpus Christi, and the city of Ingleside should not be included as an appropriate water management strategy.

In October 2008, a final report on a project in the Brownsville ship channel was submitted to the Texas Water Development Board. The initial proposal was to build a 25 MGD facility in the inner harbor. The Report includes what it reports as *fatal flaws to the concept*. Those fatal flaws included a number of specific findings relating to intake water quality, construction and operational costs, and dangers to aquatic life. In summary, the Report concluded that both intake and discharge should be in the open waters of the Gulf of Mexico. The facility was never built.

Fast forward to 2015. The legislature recognized the inherent dangers to aquatic life with intake and discharge within the bay systems and directed the GLO and Parks and Wildlife to conduct a study of the best locations along the Texas Coast where a facility could be built with its intake and discharge directly from and to the Gulf of Mexico with the least impact on aquatic life.

The GLO and Parks and Wildlife did just that and identified those zones in the Gulf. Further encouraging the intake and discharge off shore, the TCEQ then adopted an expedited process for permitting these facilities.

These actions clearly reflect that the building of facilities with intake and discharge within Coastal Bays is not an appropriate strategy.

Water management strategies that include conservation, water re-use and reclamation, and groundwater sources from the Evageline/Laguna segment of the Gulf Coast Aquifer are more than sufficient to meet the future demands of the region.

An aggressive conservation program could help municipal demand level off or decrease, even with an increase in population. A goal of 1% annual reduction in municipal consumption, which is greater than the 0.42% population growth, would defer the need for additional supplies. According to the latest TWDB study conducted in 2013, there are millions of acre feet of recoverable water available from the aquifer. While it includes fresh, brackish, and saline groundwater, fresh water is readily available and can be tapped into in as little as two years at a fraction of the costs associated with seawater desalination.

Which brings me to cost. Water management strategies must be cost effective. As noted in the IPP, the cost per 1,000 gallons of desalinated water far exceeds any other strategy. As presented in the IPP, the costs are off the charts. They reveal total *capital and indirect costs* for construction of the facilities to their desired maximum capacity range from $457.7 million to $1.281 billion. Thereafter, *annual operating costs* will range from $78 million to $218.9 million.

In time, advances in technology and science may make seawater desalination on the Gulf both cost effective and environmentally safe. In the meantime, seawater desalination as proposed in the IPP management strategies are fatally flawed and should not be included as a management strategy in the 2021 Plan. The approach is the *most expensive* and carries the *greatest risk* to the natural environment.

And lest we forget, each of the entities seeking to incorporate this strategy have acknowledged they are doing so to promote and *support industrial growth*, bringing with it the concomitant air and water quality problems that will inevitably come from industrializing the region.

For that matter, the Region N IPP should make an affirmative statement that the high water demands of chemical and petrochemical manufacturing facilities should be dissuaded from locating in an area that already has its challenges in meeting current water demands.

Recently, the Region N Subcommittee engaged in a "ranking" of the various water management strategies included in the IPP. At a minimum, if seawater desalination is determined to be a strategy, only those projects that propose both intake and discharge in the open waters of the Gulf of Mexico should be considered. None of the proposals in the IPP provide for that. In addition, those proposals are the most expensive to implement.

All these proposals should be rejected as a strategy and not receive any ranking in the subcommittee's prioritization of projects. The Region N can make a finding that a particulare strategy is *not* an appropriate one as long as Region N explains the rationale for that decision to the TWDB.

The Subcommittee has included these proposals in their "rankings", but I encourage the Region N Board to reject the rankings given to the seawater desalination projects and specifically find they are not a recommended strategy for Region N.

Finally, I am certain you are aware that the Texas Water Development Board apparently doesn't care what you include in your water management strategies, how you rank them, or what the public thinks about those strategies. On the morning of July 23, prior to the Subcommittee public hearing on the rankings, the TWDB approved the City's SWIFT loan application to build the Inner Harbor facility before you even met. The action was taken even thought the public's comments are still coming in and the Region N Board does not meet for final IPP approval in September.

The TWDB has taken you out of the process and prioritized those strategies themselves. After all the time and effort working on this Plan, I am outraged that the TWDB acted before the final IPP was submitted with the public weighing in, essentially changing the rules on the entire process.

As a member of the public, I am incensed and it raises serious questions regarding why they acted so swiftly, usurping the rights and obligations of the Region N Water Planning Group.

If these plans are intended to guide the TWDB in distributing SWIFT funds, they have already allocated a significant amount of funds that would otherwise be available for better and more cost-effective water management strategies.

Thank you for your consideration.

Errol A. Summerlin
(361) 960-5313
1017 Diomed Dr.
Portland, Tx. 78374

From: Kathryn Masten <email address redacted>

Sent: Thursday, July 23, 2020 12:12 PM

To: jbyrum@nueces-ra.org

Subject: Important Suggestion for Today's 2pm Prioritization Meeting

Hello Mr. Byrum,

I apologize for the last minute nature of my email, but I wanted to put before you an important suggestion when your group prioritizes water management strategies today. It is that a distinction be made between two (2) Seawater Desalination Strategies in the 2021 Region N Plan (distinctions that could not be made in the 2016 Plan):

* "Off-Shore" Seawater Desalination (recommended). This category would include desalination plants with BOTH intake (water diversion) and discharge located off-shore

AND away from inlets (regardless of the location of the physical plant itself), as recommended in the 2018 “Marine Seawater Desalination Diversion and Discharge Zones

Study” by TPWD and GLO (for the 84th State Legislature). As shown in Figures 6 and 7 of this report, the recommended zones reflect the need to protect the State's important bay and estuary ecological systems. An expedited TCEQ permitting process was established to encourage industry to follow the study's recommendations (but that didn't seem to work, since none of the projects in the current plan are proposed to be off-shore).

* “Non-Off-Shore” Seawater Desalination (not recommended). This category would be anything else. This includes, but is not limited to, projects on the draft plan that propose

EITHER intake OR discharge into the La Quinta Channel (adjacent to the cities of Portland and Ingleside on the Bay) or Harbor Island (adjacent to Port Aransas).

I will provide more detailed comments by the August 1st deadline, as I continue to speak with area scientists and concerned citizens in my role as Executive Director of the Ingleside on the Bay Coastal Watch Association (IOBCWA.org). I respectfully request that this proposal be discussed at today's meeting. Feel free to share this email.

Also, please add me to the mailing list for meeting notices (email preferred at

<redacted>).

Thank you,

Kathryn Masten, Ph.D.

Executive Director, Ingleside on the Bay Coastal Watch Association

<contact info redacted>

Comments on the Coastal Bend Regional Water Plan (CBRWP)

From the Ingleside on the Bay Coastal Watch Association
August 1, 2020

Staff
Executive Director, Kathryn Masten, Ph.D.
Administrative Assistant, Emily Nye

Board of Directors
President, Patrick Nye
Vice-President, Chris Carleton
Secretary, Shelley Williams
Treasurer, Jennifer Hilliard
Director, Craig Wadham

Committee Chairs
Tom Daly, Desalination Committee Chair and Ingleside on the Bay City Council Member
Randy Cain, Air Quality Committee Chair and Ingleside on the Bay City Council Member

Thank you for the opportunity to comment on the Coastal Bend Regional Work Plan (CBRWP). We recognize that a significant amount of effort has gone into the preparation of this 942-page document – both by paid staff and by many volunteers representing different segments of our region. However, since our small community has not had an active role in preparing the plan, yet stands to be significantly impacted by several of the recommended water strategies for seawater desalination, it is incumbent upon our organization to point out some of the weaknesses in the plan, as well as make recommendations for improving it.

Lack of Notice to the City of Ingleside on the Bay

Established over 60 years ago, Ingleside on the Bay (IOB) is an incorporated city of about 700 people located at the confluence of La Quinta Channel and the Corpus Christi Ship Channel in San Patricio County. Because our population is less than 1000, our mayor does not directly receive notices about regional water planning activities. Yet, three of the five marine desalination projects identified as "recommended water management strategies" in the CBRWP are located on La Quinta Channel adjacent to our community. The figure below shows IOB's location in relationship to La Quinta Channel and one of the proposed plants (3 miles downstream from the proposed Corpus Christi plant).

Recommendation: We recommend that the CBRWP include language encouraging the State to modify legislation to ensure that ALL of Texas' incorporated cities, regardless of size, receive proper notification.

Lack of Notice to Environmental Organizations in the Coastal Bend

Recognizing that industries were suddenly encroaching all around us, the 501(c)(3) Ingleside on the Bay Coastal Watch Association (IOBCWA) was incorporated in September 2019 to "promote the health, safety, and quality of life for residents of Ingleside on the Bay through research, education, communication, and action". In our brief existence so far, a significant part of our activities has been learning about desalination and its potential impacts on our community in order to make knowledgeable public comments on these TCEQ permits, channel deepening, and the many other industrialization activities that will impact the very existence of coastal communities. Our most reliable source of information has been the Coastal Alliance to Protect the Environment (CAPE), which is an alliance of nearly twenty of the Coastal Bend's environmental organizations. Yet even CAPE has been left out of the loop on some of the Regional Water Planning Group (RWPG) meetings. Individually, the environmental organizations in the Coastal Bend have our particular areas of interest. Collectively, we take action to promote efforts to preserve the Coastal Bend's precious and unique system of bays and estuaries. We are concerned the lack of attention paid by the State of Texas to the cumulative impacts of all this industrialization, and sometimes seemingly deliberate efforts to keep us unaware of activities relating to industrialization and permitting. This represents an opportunity for the RWPG. A tremendous amount of energy was put into this Plan, and industries with paid staff and money at stake are able to have significant input into such a Plan's crafting. Nonprofit environmental organizations and small communities impacted by the recommended water management strategies do not have the luxury of such expertise and funding.

Recommendation: Create a central notification email list, to ensure that all environmental organizations in the Coastal Bend are kept informed of ALL Water Planning and TCEQ water permitting activity. Also, reach out to CAPE when assembling stakeholder committees and other working groups.

Lack of Emphasis on Protection of Natural Resources

Senate Bill 1, enacted in 1997 by the 75th Legislature and referenced in the Executive Summary of the CBRWP, defines the purpose of the regional water planning effort. Included within this purpose statement is the mission to "protect the agricultural and natural resources of [a] particular region." Among the abundant natural resources of the Coastal Bend Region are her bays and estuaries. However in section 1.7, when the CBRWP lists specific threats to the agricultural and natural resources of the Coastal Bend, it fails to identify the deterioration of water quality within Corpus Christi Bay, Nueces Bay, La Quinta Channel, and Inner Harbor as well as the devastation of marine life, including shrimp, oysters, trout, red fish, flounder, and drum, as potential threats due to the locating of seawater intake and brine discharge from desalination facilities within the bay system.

Recommendation: Corpus Christi Bay, Nueces Bay, La Quinta Channel, and Inner Harbor should all be recognized in section 1.7 of the CBRWP as valuable natural resources and all potential threats to the water quality of the Coastal Bend's bays and estuaries should be identified, including but not limited to increased salinity, pollution, decreased oxygen levels, and the destruction of sea grass and marine life.

Definition of the RWPG as "Reconnaissance-Level Effort"

Section 5B.1 of the CBRWP states that "regional planning is a reconnaissance-level effort and a detailed investigation of project impacts is beyond the scope and mandate of this effort." The language and sentiment of this statement is in contrast to the mandate outlined in § 357.35 of the Texas Administrative Code: "RWPGs shall recommend specific WMSs [water management strategies] and WMSPs [water management strategy projects] based upon the identification, analysis, and comparison of WMSs by the RWPG that the RWPG determines are potentially feasible so that the cost effective WMSs that are environmentally sensitive are considered and adopted…" The acts of recommending WMSs "based upon identification, analysis, and comparison" and determining feasibility based on cost effectiveness and environmental sensitivity go beyond the scope of mere "reconnaissance." According to the Texas Administrative Code, the RWPG does not merely gather information, but also judges the merits of particular WMSs/WMSPs and provides recommendations in accordance with such judgements – recommendations that carry significant weight. For example, the inclusion of a particular project as a "recommended WMS" supports getting a project funded, which is a significant milestone toward implementation. In the case of the Corpus Christi La Quinta Desalination project, because it was included as a "recommended WMS" on the 2016 Region N Water Plan, it was able to be approved for funding by TWDB on the very same day we were making comments on its merits during discussions about the 2021 Plan.

It is disconcerting that not only does the language of the CBRWP downplay the responsibility of the regional planning group but also that at the Region N Subcommittee meeting on the Prioritization of Recommended Water Management Strategies held at 2:00pm on July 23, 2020, the chair, Kristine Shaw, expressed a similar sentiment. She stated:

> "The task of the RWPG is to develop a plan to meet the region's 50-year projection – out to 2070. And, as part of that, those that serve on the planning group spend hours putting together thoughts on what direction the plan is going to go in. Put simply, the historical background is that those water utility or user groups that have identified projects and for which there is a sponsor, that those projects are shown as 'recommended strategies' and in that way, the plan does not get in the way regarding sponsors that want to move forward with respect to SWIFT funding or other funding programs."

According to Ms. Shaw, historically the RWPG identifies those projects put forward by water utility or user groups, assures that there is a sponsor for the projects, and subsequently grants its approval of such projects as "recommended." If Ms. Shaw's portrayal of the regional planning process is accurate, the actions of the regional water planning group fall far short of the analyses, comparisons, and determinations mandated by the Texas Administrative Code.

Recommendation: The statement in section 5B.1 of the CBRWP which states that "regional planning is a reconnaissance-level effort and a detailed investigation of project impacts is beyond the scope and mandate of this effort" should be removed, and additional clarity regarding the responsibility and impacts of the regional planning groups to render judgment on proposed WMSs and WMSPs should be provided both to the planning group and the general public.

Insufficient Consideration for "Environmental Sensitivity"

As referenced above, Texas Administrative Code § 357.35 states: "RWPGs shall recommend specific WMSs and WMSPs based upon the identification, analysis, and comparison of WMSs by the RWPG that the RWPG determines are potentially feasible so that the cost effective WMSs that are environmentally sensitive are considered and adopted…" According to the legislative code, "recommended" WMSs and WMSPs have been determined by the RWPG to be "environmentally sensitive." Given that (A) all five "recommended" WMSPs included in the CBRWP have intake and discharge locations within the Corpus Christi Bay system, and (B) given that the analysis of environmental issues provided by the RWPG recognizes seawater intake and brine discharge within the Coastal Bend's bays and estuaries as having potentially severe environmental repercussions, it does not follow that (C) such projects are "environmentally sensitive." The surest way to for desal to be "environmentally sensitive" is to follow the recommendations for expedited permit processing in the TPWD/GLO Study. It was disappointing that NONE of the desalination projects included in the CBRWP chose to locate intake/discharge offshore. Clearly, expedited permit processing is an insufficient incentive for industry to do the right thing. Perhaps not "recommending" these projects will be more of an incentive.

During the Region N Subcommittee meeting on the Prioritization of Recommended Water Management Strategies held at 2:00pm on July 23, 2020, one of our members, Emily Nye, specifically asked the subcommittee for clarification regarding whether or not the environmental impact of a proposed WMS was considered in determining whether or not a water management strategy should be "recommended." Ms. Nye asked: "So, in other words, every project is going to be included no matter what – how negative or positive the environmental impact would be?" [Silence] "Do you see what I am saying? Where is the responsibility, this is what I am wondering, here's my question – where's the responsibility of the planning group in identifying a project that would so adversely negatively impact the environment that the responsible thing to do would be not to include it on the plan?" Kristine Shaw responded: "Planning group takes up as part of the initially prepared plan and also the final plan the comments that are coming in and public comment with respect to where the strategies are and where the needs are and whether or not there are sponsors associated with those strategies…the recommended strategies have been developed, discussed, and presented at the planning group meetings over the past two and a half years and during the last meeting in February they were approved to show as recommended strategies to meet particular needs or for water user groups that have specifically requested those strategies." Not only did Ms. Shaw's response not answer the question, in her explanation of the approval process for WMSs and WMSPs, she specifically excluded any indication that environmental considerations played a role in planning group's ultimate "recommendation" of such strategies. According to Ms. Shaw's testimony, it appears that the recommended WMSs and WMSPs currently included in the 2021 CBRWP have not been scrutinized at the level required by the Texas Administrative Code.

Recommendation: While seawater desalination may no doubt be conducted in both a cost effective and environmentally sensitive manner, the CBRWP should specifically outline how and under what parameters a seawater desalination facility in the Coastal Bend Region would be considered "environmentally sensitive" and, therefore, "recommended" by the CBRWP such as the condition that seawater intake and brine discharge be located offshore.

Lack of Consideration of Cumulative Impacts from Multiple Desalination Plants

As stated in Texas Administrative Code Sec. 16.053: Each regional water plan must identify the "effect of upstream development on the bays, estuaries, and arms of the Gulf of Mexico". The flow for all three of the proposed La Quinta Channel desalination plants is generally southward toward Ingleside on the Bay, out to Corpus Christi Bay, then on toward the Gulf of Mexico. There are many other industrial sites located upstream from IOB in La Quinta Channel. It is our community that is in directly line to suffer consequences from upstream development. However, there is no assessment in the CBRWP of the cumulative impact of having three desalination plants in the Channel, coupled with other industries, let alone the effects of channel deepening and ship traffic on water flow and flooding.

Recommendation:
Identify potential cumulative impacts in the CBRWP, add a flag for "possible cumulative impacts" in the assessment rubric, and strengthen policy recommendations to ensure that a formal cumulative impacts assessment is conducted prior to any new project being implemented, as situations can and do change.

Lack of Visibility of La Quinta Channel Despite Prominence in CBRWP

Wastewater permits for two of the three La Quinta seawater desalination plants have already been declared administratively complete by TCEQ. However, the area of Corpus Christi Bay that is referred to as La Quinta Channel is a nearly closed system. It's 4.5 miles long, but only 2000 feet wide, with a shallow 1000' opening on the northwesterly end, second shallow opening on the westerly side of 450', and a 700' opening on the southeast side. At nearly 11.5 times as long as it is wide, this part of the Bay is better thought of as a river or bayou that empties into Corpus Christi Bay than as a part of the Bay itself. However, La Quinta Channel is not identified separately in the 305(b) Water Inventory, and therefore has not been examined distinctly for sampling, impairment assessment, and possible inclusion on Texas' 303(d) list.

Recommendation: We recommend that the RWPG encourage the State to establish La Quinta Channel as a distinct water segment for purposes of sampling, monitoring, and reporting.

Insufficient Assessment of Environmental Impacts

Our community is understandably concerned, and models and studies have confirmed, that hypersalinity from significant and cumulative amounts of brine discharge into La Quinta Channel would threaten the marine life in La Quinta Channel and Ingleside Cove, an estuary adjacent to IOB that is the source of water for our city's canal, along which many of our residents live. The impact of saline and sedimentation on seagrasses and benthic populations is likely to be severe. If marine life in Ingleside Cove suffers, this would, in turn, drive away the sea birds, turtles, and dolphins that depend on the Channel for food source and habitat. This in turn would threaten the livelihoods of commercial fishing, fishing guides, and shrimping operators based out of Ingleside Cove, impact recreational opportunities for our citizens (e.g. swimming, boating, kayaking, bird watching), and affect our bayside businesses, including the Bahia Marina, Sunset Hideaway restaurant, and Fireside Market, which make up most of IOB's city sale tax revenues. Destruction of aquatic life in Ingleside Cove would contribute to blight and lessen property values in our city. People choose to live, play, and retire in IOB and other coastal communities because of their proximity to water. Corpus Christi Bay is IOB's lifeblood. Yet, at the prioritization meeting on 7/23/20 at 2pm, when we asked whether the TWPG should "take into account the negative environmental impacts of a particular water strategy" before recommending it, we were informed that, while environmental concerns are included in Chapter 5D of the CBRWP, the more detailed assessment of environmental impacts is left primarily for the TCEQ permitting process. The scoring rubric for the prioritization process itself consisted only of those elements listed in Texas Water Code Sec. 13.436 (decade needed, feasibility, viability, sustainability, and cost-effectiveness). These elements focus on a project's readiness rather than its "desirability".

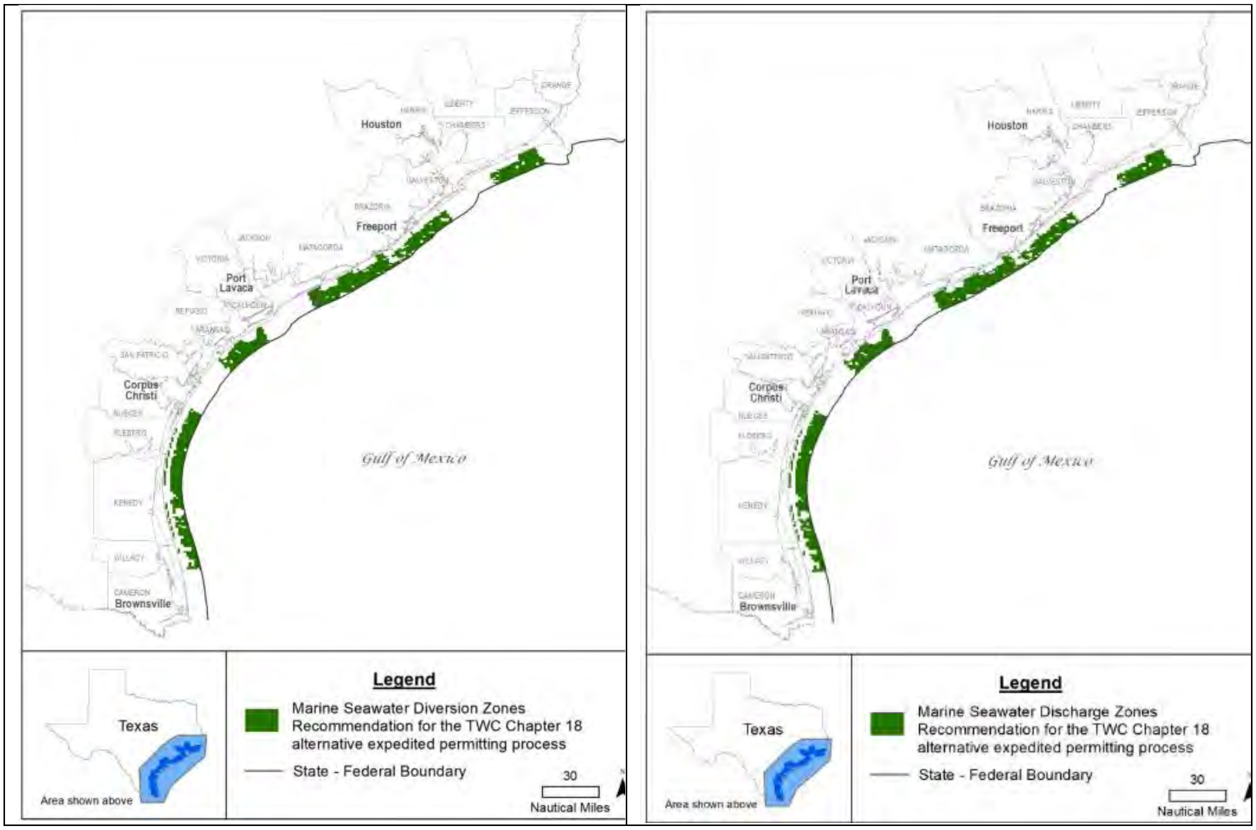
Recommendation: We recommend that the scoring rubric for prioritizing projects in Texas Water Code Sec. 13.436 be expanded to include level of Public Interest, consideration of Environmental Concerns, and recommendations from Studies conducted by Texas Parks and Wildlife (TPWD) and researchers from Texas universities.

Intake/Discharge Placement for Seawater Desalination should Occur Offshore

The CBRWP references the Legislatively-mandated TPWD/GLO study "Marine Seawater Desalination Diversion and Discharge Zones Study" of 2018, but overlooks its central conclusion: To protect our bays and estuaries, the intake and discharge points of seawater desalination projects should be located offshore. Conversations with scientists from Texas A&M Corpus Christi and University of Texas reinforce this central conclusion. The only barrier to taking intake/discharge offshore is the higher cost. There are only two other seawater desalination plants in operation in the United States: Carlsbad near San Diego, California, which is located on a point that opens directly to the Pacific Ocean, and Tampa Bay, Florida, which opens onto a large bay. Neither of these compares to narrow and relatively closed La Quinta Channel. Scientific evidence provided by TPWD and GLO in their 2018 report, as well as modeling (such as that done by LRE Water using the SUNTANS model and others), show that the marine environment in La Quinta Channel cannot withstand the level of brine discharge being proposed. While there may be some ways to further mitigate intake/discharge inside the Channel, to do so in the state's first seawater desalination plants represents too risky an experiment – leading to potentially devastating and permanent consequences to IOB and the Corpus Christi Bay system. This level of risk and potential harm needs to be reflected in the CBRWP and in the scoring rubric, before such projects are deemed "recommended water management strategies".

Recommendation: We recommend that a distinction be made in the CBRWP between the water management strategies of "Offshore Marine Desalination" (classified as "recommended" based on diversion and discharge zones recommended by TPWD/GLO as shown in the figures below – not only off-shore, but also sufficiently far away from inlets to bays and estuaries) and "Other Marine Desalination (classified as "not recommended" for every other proposed location). We also recommend that the Scoring rubric in TWC Sec. 13.436 be expanded to include "Disqualifying Criteria".

Figure 1: Recommended Diversion (Intake) and Discharge Zones from TPWD and GLO Study



Concerns about Contracts with Industry

Throughout the CBRWP, it becomes clear that the projected water shortages are not due to the modest expected population growth in the Coastal Bend, but to the needs of industry. We are particularly troubled by the statement "The city [of Corpus Christi] does not currently have the supply to provide the full contracted purchases after 2020, and therefore SPMWD [San Patricio Municipal Water District] shows increasing water supply shortages from 2030-2070" (Section ES.8). Did our major water supplier (City of Corpus Christi) make a promise to industries that it cannot keep? Is it wise to fix this problem by building expensive and risky seawater desalination plants in order to encourage even more industries with high water needs to locate in the drought-prone Coastal Bend? This does not support the conservation emphasis in Texas statute for regional water planning.

Recommendation: Project prioritization should include consideration of "Other Factors", perhaps with the option of applying negative points.

Insufficient Consideration of Financial Impacts

As shown in the various tables comparing the projects, desalination is the most expensive by far of the proposed water management strategies. Project approval by TWDB for taxpayer-supported funding deserves much more scrutiny than appears to have been received. For example, what guarantee is there that industries will continue to pay the Voluntary Drought Exemption Fee for the Corpus Christi desalination plants once those plants are built (only half of them pay the fee now), that industries won't go bankrupt like M&G Resins did on the Inner Harbor a few years ago, and that when there is a drought, non-industrial customers can still get sufficient water. Yet, financial aspects are not considered when determining whether or not to recommend a strategy.

Recommendation: We recommend that the scoring rubric for prioritizing projects be expanded to include Financial Considerations.

Lack of Ability to Review Scored Projects

While we appreciated the lively exchange during the 7/23/20 2pm Prioritization meeting (which we only accidentally found out about), we have since requested to see the resulting prioritization spreadsheet and scoring rubric. Those have not been forthcoming, so we are limited in our ability to critique the method and results of the scoring. The meeting notice, scoring rubric, and pre-scored projects should have been made available ahead of time via the TWDB/Region N website.

Recommendation: We recommend that due consideration be made to the suggestions made by IOBCWA and its members, as well as those of other public participants, during the June 2nd public hearing, the July 23rd public comments, and this document. Also, please make sure the website reflects upcoming events. We really are interested!

Summary

In a separate email, IOBCWA Board President has prepared more substantive comments and images, so that you can get a better sense of what has caused so much alarm – not only among Ingleside on the Bay residents, but in other coastal communities as well, like Port Aransas and Portland. We do hope you will take our concerns and suggestions under consideration. Also, please know that we are more than willing to assist in incorporating any of these suggestions into a revised draft of the CBRWP.

Thanks again for your hard work. We hope you find these comments to be helpful.

SURFRIDER FOUNDATION
TEXAS COASTAL BEND

RECEIVED
AUG 03 2020

Surfrider Foundation
Texas Coastal Bend Chapter
122 Whiteley Drive
Corpus Christi, TX 78418
coastalbend.surfrider.org

July 20, 2020

Coastal Bend Regional Water Planning Group (Region N)
602 N. Staples Street, Suite 280
Corpus Christi, TX 78401

Dear Carola Serrato and Scott Bledsoe, III,

The Surfrider Foundation is a national non-profit organization dedicated to the protection and enjoyment of the world's oceans, waves and beaches, for all people, through a powerful activist network. While much of our local work is focused on the Gulf of Mexico and the adjacent beaches, we recognize that all waters in a watershed are interconnected and that human activities in one part of a watershed can affect other areas in the same watershed. As such, potential negative impacts on the health of Corpus Christi Bay may affect nearby waters, habitats and the wildlife that live there.

We appreciate the hard work done by the Coastal Bend Regional Water Planning Group (Region N) in preparing the Initially Prepared Plan to help ensure a reliable long-term supply of water for the Coastal Bend region. We would like to make the following comments regarding the plan:

On page 15, the plan states, "Five seawater desalination plants are recommended for Nueces and San Patricio County manufacturing users…". We are concerned about the potential cumulative impact of brine discharge from those five plants, with the largest plant producing 100 MGD of water, into Nueces and Corpus Christi Bays. A recent study titled "Water Quality trends in Texas estuaries" by Harte Research Institute scientists (Kalman Bugica, et al., 2020) showed that "Significant annual increases in salinity were observed at four sites in Corpus Christi Bay, four sites in Nueces Bay…" and that the "decrease in freshwater inflow drives another major water quality concern affecting mid-coast estuaries in Texas, namely a long-term increase in the salinity. This has important implications for estuarine organisms that are sensitive to high salinities." Given the years of effort undertaken to ensure that freshwater flows into Nueces Bay have been maintained, concerns about increasing salinity should be taken seriously.

Per Dr. Andrew Samson's book, Water in Texas, it takes a little over 2 years for the water in Corpus Christi Bay to be exchanged. According to Freese and Nichols employees, this duration is closer to 1.4 years. Whichever it is, there are few inlets and outlets to the bay, and no one has determined what the possible impacts on the health of the bay may be if all five plants are constructed.

When HB 2031 was passed in the 84th Texas Legislature, it directed TCEQ to expedite permitting for proposed plants with intakes and discharges in the Gulf, and dropped the permitting requirement entirely if the intake and discharge are located more than three miles offshore. It also required TPWD's and GLO to conduct a study "to identify zones in the Gulf of Mexico that are appropriate for the diversion of marine seawater and for the discharge of wastewater resulting from the desalination of marine seawater..." Clearly the legislators considered the Gulf to be the optimal location for desalination intakes and brine discharge.

Rather than considering our bays to be convenient dumping grounds for the multitude of industrial discharges coming to the Coastal Bend, our leaders and regional planners should take every step possible to protect them. When it comes to water planning, more emphasis should be placed on industrial reuse, and municipal reuse and conservation. These are less expensive and environmentally friendlier strategies than building costly seawater desalination facilities that threaten the bays.

Sincerely,

Cliff M. Schlabach

Cliff Schlabach
Chair

Neil McQueen
Vice Chair

From: Wendy Hughes
Sent: Friday, June 5, 2020 12:39 PM
To: regionnfeedback@nueces-ra.org
Subject: Desal project comments

I appreciated the virtual meeting this past Tuesday. However, I hadn't had time to prepare any comments then. I feel Desal plants will damage wetlands & spawning grounds for shrimp, crabs, & fish. Our economy & way of life depends on fishing & tourism. They will also damage seagrasses & prime fishing habitat for shrimp, crabs & gamefish as well as waterfowl, shorebirds & turtles. We will also be subjected to unfathomable levels of pollution resulting from all the planned fossil fuel and plastics industries that the desalination plants would be supplying water to. There is no need to destroy our bays. There are other less expensive, more environmentally friendly strategies that don't put this intense risk to our bays. The LaQuinta Channel seems especially vulnerable since it is a smaller area.

Thank you.

Wendy Hughes

<contact information redacted>

From: Jennifer Hilliard
Sent: Tuesday, June 2, 2020 3:55 PM
To: regionnfeedback@nueces-ra.org
Subject: Comments on the current Region N

Seawater desalination, as currently proposed, should not be included as a management strategy in the Region N 2021 Plan. The approach is the *most expensive* and carries the *greatest risk* to the natural environment. More importantly, each of the entities seeking to incorporate this strategy have acknowledged they are doing so to promote and *support industrial growth*, bringing with it the concomitant air and water quality problems that will inevitably come. The study provided by the Texas Parks and Wildlife for hb2031 specifically directed these facilities to bring their intake from and take their discharge offshore. The extra cost to direct the intake and discharge offshore could be shouldered by the industrial companies that are using this water and making a profit.

The bottom line, seawater desalination is not an appropriate water management strategy for the Corpus Christi Bay and adjacent inshore bodies of water for the Region N counties.

Respectfully,

Jennifer Hilliard, AIA LEED AP BD+C

<contact info redacted>

***Response*-**
Desalination

Response:

Thank you Hamlet, Randy, Emily, Patrick, Encarnacion, Errol, Kathryn, Cliff, Neil, Wendy, Jennifer, and associated organizations for providing comments on the 2021 Initially Prepared Plan. All public comments received were considered. The 2021 Initially Prepared Plan recommends conservation, water reuse, and groundwater sources as inquired in comments. The plan includes water savings of 18,793 ac-ft/yr attributed to municipal water conservation (Table 5D.1.11), reuse opportunities in conjunction with aquifer storage and recovery for 14,573 ac-ft/yr to 20,178 ac-ft/yr, and development of groundwater supplies amounting to about 45,000 ac-ft/yr for the 11-county area, as well as seawater desalination and other strategies to meet long-term needs through 2070.

Many of the desalination comments extend outside of the purview of regional water planning activities, which are solely associated with planning *not* project implementation. Project implementation is the process for project sponsors, including permitting and other policy requirements (and public notice process) prior to construction. It continues to be the position of the Coastal Bend Regional Water Planning group to focus on long-term planning according to TWDB guidance and to include strategies requested by water user groups within the region in order to have a relevant, practical, and flexible regional water plan to accommodate water user group and major water provider needs. Project sponsors can then leverage the planning-level information in the Regional Water Plan to deepen site-specific project evaluations toward implementation according to their needs, which includes permitting. This is not, however, the scope of the Regional Water Planning Group.

Texas Administrative Code Chapter 357 addresses specific tasks and work to be included in Regional Water Plans which includes identification of a process of identifying potentially feasible water management strategies and information to include in water management strategy (WMS) evaluations. On August 10, 2017, Region N adopted the process of identifying potentially feasible WMS for the Coastal Bend Region (Figure 5A.1.2 in Initially Prepared Plan). 31 TAC 357.34 (c) (2) requires RWPGs to consider seawater desalination, brackish groundwater desalination, aquifer storage and recovery, and additional types of projects. At the May 10, 2018 Region N meeting, a subcommittee consisting of Region N members was formed to discuss potentially feasible water management strategies. The subcommittee met on June 27, 2018 to discuss strategies identified in previous plans, by water providers, and other stakeholders in the region and identified projects to evaluate and include in the plan given required materials to include in the plan to be administratively complete and TWDB funding constraints. Region N meetings in 2018 and 2019 discussed each WMS evaluation included in the plan in detail. At the November 14, 2019 and January 6, 2020 Region N meetings, the Region N discussed which evaluated strategies would be recommended WMS based on sponsor-interest and needs over the 2020-2070 planning period.

Comments that are specifically addressed through revisions to the Plan include:

- Are raw water supply costs (for groundwater project) shown in the plan? *Response*: Yes, shown in Chapter 5D.8. Only one project that utilizes supply from a given source can be shown as recommended, and based on wholesale water provider feedback the treated groundwater strategy is the recommended strategy shown.
- Did costs for the Port's Harbor Island and La Quinta Channel sites assume 500 mg/L TDS produced water like those of the City's desalination projects? *Response:* The unified costing model estimates treatment costs to get water to drinking water standards. The modeled cost for the RWP has three input variables: treatment level, TDS estimated (raw water), and plant capacity. For treatment levels: 4 for reverse osmosis- brackish which is considerably less expensive than 5 seawater desalination. For comparison Level 4 treatment of 21 MGD plant is $57M. Level 5 treatment of 21 MGD plant is around $224M.
- Does Port's Harbor Island facility cost need to be changed given their new plans to put the intake pipe in the Gulf? *Response:* HDR spoke with Port and the information provided to Region N is consistent with their current plans (as of July 23, 2020). HDR spoke with TWDB staff for guidance on this situation, in case it is applicable to other projects. When sponsors seek TWDB funding, the project is evaluated with respect to consistency with the regional water plan understanding that often the project changes slightly during permitting, land procurement, and other aspects while advancing toward project implementation. If significant changes are made to the project (i.e. project changes size, yield, major infrastructure changes to a different county, etc) then the sponsor may need to request a minor amendment to an adopted plan. Smaller changes don't require updates.
- Table 5D.10-4 is missing the dollar amount label for debt service. Pumping energy costs are not included in the annual costs for the City's Inner Harbor and La Quinta desalination projects. *Response:* Thanks for alerting to this. It has been updated in 5D.10-4 to include the label for debt service. Bottom-line costs remain the same. According to the City of Corpus Christi, the desalination treatment plants are located very close (< 1,000 feet) from distribution system and therefore no additional pumping is anticipated.

Public Comments-
Atmospheric water generation technology

From: Andrew Sowder
Sent: Tuesday, June 9, 2020 12:13 PM
To: mcgserrato@STWA.org
Subject: Region N / Atmospheric Water Generation Inclusion: TX 2022 Water Plan

Hello Ms. Serrato,

As a Regional Water Planning Group Chairperson of Region N, you are knowledgeable of how the Water Cycle produces rain. Atmospheric Water Generation technology *produces* water using the same Water Cycle process, which you will hopefully agree makes it an *innovative technology* it worthy of including in Texas' 2022 Water Plan.

Water Cycle Atmospheric Water Generation Tech'

· In the Water Cycle, warm humid air rises into the atmosphere.	· An Atmospheric Water Generation machine draws warm humid air into a chamber.
· Atmospheric temperature cools at higher altitudes, so as the rising warm humid air ascends it into the cooler temperature zones it begins to condensate forming clouds	· The chamber is temperature controlled, which enables cooling of the warm humid air to a temperature that begins condensation.
· When the atmospheric temperature around the cloud cools to the Dewpoint temperature rain occurs.	· When the temperature in the chamber is cooled to the Dewpoint temperature droplets form which fall into a collection pan, then flow out through a valve.

You may have seen examples of Atmospheric Water Generation technology on a hot-humid Texas day when you turned on your car's AC. Your AC cooled the air blowing out of your car's defrost vent. The cold air blowing from the defrost vent cooled your windshield to the Dewpoint temperature. Warm humid air contacting the cooled party of your windshield began to condensate turning into water drops.

One small cloud makes a little rain, and many small clouds make enough rain to fill aquafers, lakes, and rivers, the same is true of a distributive Atmospheric Water Generation network. Advancements in Atmospheric Water Generation now make it an economically scalable technology, capable of onsite residential/commercial water production from hundreds of gallons to acre feet of water for municipal, aquafer and reservoir supply. The aggregate potential of a distributive Atmospheric Water Generation network would substantially mitigate drought induced water supply shortages.

The following information and attached files contain documentation and contacts for your review: Economic energy / gallons produced ratio, Validation of economic operability, and

Military sales that will hopefully prompt your inclusion of Atmospheric Water Generation in Texas' 2022 Water Plan as an innovative technology for *producin*g water.

This information has also been sent to TWDB's Planning Group Regional Managers Innovative Water Technology staff, and others in hopes of AWG implementation.

Thank for your consideration, Andrew Sowder

512-299-4290 (Cell) / asowder@sbcglobal.net

Introduction: Mr. Moses West, AWG Contracting, has developed an economic, environmentally viable Atmospheric Water Generator (AWG) that fulfills many of the stated goals in Texas' 2017 Water Plan.

2017 Water Plan: AWG *creates* water, all other technologies referenced in the report draw upon existing water supplies. AWG is capable of both supplementing water systems and reservoirs during non-drought periods and *supplying* water during droughts.

Notations highlighting AWG's ability to meet Texas 2017 Water Plan's goals and requirements are in attachment: TWDB_ 2017 St Water Plan AWG Notes.

Economy of AWG Production: Dr. Les Shephard, 2015 Trinity University Test Data.

"Bottom line is that to produce 1-acre foot ~ 365000 gallons would take nominally 340,000 kWh - a rough number at 50% RH (estimated 0.93 kWh/g) - based on real data and real operational environment measurements for Texas."

"I think the estimate seems reasonable given the data we collected 5 years ago (2015) - given the appropriate number of new machines I sense we could do better, but this is a good estimate. The data indicates that to produce an acre-foot per day will require about 450 machines (~10' by 20' by 8' per container - that is a large number and may be a little conservative based on 50% RH). It will also place a localized load on the electric distribution system. I don't know anything about the cost of these machines and a common question we get is what are the local environmental impacts. Depending on machine spacing, the impacts should be minimal - however we have not made actual T/RH measurements of the air around the machine while it is operational. Two major advantages of these units, as you know, is that they can be moved to minimize the need for infrastructure buildout and the water can be treated to tailored specifications if necessary, on location."

Validation: Vieques, Puerto Rico, September 2015. Engineer and Project Manager John Saggese's independent paper, Atmospheric Water Generation, An Opportunity in Disaster Relief documents production by Mr. West's AWG of over 400,000 gallons of water between June 4th – August 6th of 2015.

Mr.Saggese's paper is attachment: Atmospheric Water Generation_J Saggese.pdf.

Mr. West has increased his AWG's efficiency since 2015; it is arguably the most economically efficient technology currently available, hence the United States Marines have recently purchased two(2) AWGs, and Texas National Guard four (4) AWGs to date.

AWG Contracting's Chief of Contracting Officer, Dexter Moon, can supply information regarding the current generation of AWGs.

Implementation: AWG is a scalable technology that can be implemented in either a distributive manner with onsite AWGs tying into existing residential and commercial water systems, or centralized supplying reservoirs, aquifers, treatment plant, pump station, etc.

A distributive AWG system with on-site solar, wind, and geothermal electrical generation, would be a win-win for both Texas' electric and water utilities. AWG's with on-site electrical generation when not producing water would supply electricity to the grid.

Emergency Relief: A distributive AWG/Electric Generation system would greatly mitigate the impact severe weather events by reducing the size of outage areas. Independent/onsite systems would be closer to areas in need minimizing distribution logistics.

Outreach/Education: Mr. West is assisting with the development curriculum about atmospheric water as a viable base of a water supply and hopes to see future vocational programs for high school and beyond.

Business Information: AWG Contracting LLC. ttps://awgcontractingus.com/#
Mr. West Interview : Univ. of TX: 2020 Earth Day TRACS talk by Moses West entitled "Out of Thin Air" / https://www.youtube.com/watch?v=vEoFztNuFQI / "Phillips, Kristin E" <kristin.phillips@austin.utexas.edu> or sustainability@austin.utexas.edu

Contact information:

<redacted>

Conclusion: Thank you for your time and consideration.

I'd appreciate any future opportunity that might be available assist the TWDB in its efforts to insure Texas with an economic and environmentally sustainable water supply.

Andrew Sowder

Email:<redacted>

***Response*-**
Atmospheric water generation technology

Response: No change in text. Carola Serrato, Region N co-chair, provided the following response to Mr. Sowder on June 9, 2020.

Mr. Sowder,

Thank-you for your interest in the Water Planning process. However, the inclusion of any type of project or strategy related to Atmospheric Water Generation will not be possible due to the timing of your email as well as the TWDB process. The timeline for submittal of the Plan is nearing the end. In fact, the Initially Prepared Plan has already been released for comment. In addition, TWDB rules require that projects have a sponsor which translates into a political subdivision willing to implement the project. Attached is a two-page summary of RWPG's responsibilities and, perhaps as important, what our Groups don't do.

Hope this helps,

Carola G. Serrato

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